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# **DRAFT of 2/12/02 of *Superfund* *Lead-Contaminated* *Residential Sites Handbook***

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**Prepared by the**

**Environmental Protection Agency  
Lead Sites Workgroup (LSW)**

## **NOTICE**

**This document has been reviewed in accordance with U.S. EPA policy and is approved for publication. Mention of trade names or commercial products does not constitute endorsement of recommendation.**

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## DISCLAIMER

This document provides guidance to EPA Regions concerning how the Agency intends to exercise its discretion in implementing one aspect of the CERCLA remedy selection process. The guidance is designed to implement national policy on these issues.

Some of the statutory provisions described in this document contain legally binding requirements. However, this document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. Any decisions regarding a particular remedy selection decision will be made based on the statute and regulations, and EPA decisionmakers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate.

Interested parties are free to raise questions and objections about the substance of this guidance and the appropriateness of the application of this guidance to a particular situation, and the Agency welcomes public input on this document at any time. EPA may change this guidance in the future.

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# ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements	IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead in Children
ASTM	American Society for Testing and Materials	LSCG	Lead Sites Consultation Group
ASTSWMO	Association of State and Territorial Solid Waste Management Officials	NCP	National Contingency Plan
ATSDR	Agency for Toxic Substances and Disease Registry	NLLAP	National Lead Laboratory Accreditation Program
BMPs	Best Management Practices	NTCRA	Non-Time-Critical Removal Action
BRAC	Base Realignment and Closure	PRG	Preliminary Remediation Goal
CAGs	Community Advisory Groups	PRP	Potentially Responsible Party
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	RCRA	Resource Conservation and Recovery Act
CIS	Community Involvement Specialist	RPM	Remedial Project Manager
DOD	Department of Defense	SEP	Supplemental Environmental Project
FOSL	Findings of Suitability to Lease	TAG	Technical Assistance Grant
FOST	Findings of Suitability to Transfer	TCLP	Toxicity Characteristic Leaching Procedure
FP-XRF	Field Portable X-Ray Fluorescence	TCRA	Time-Critical Removal Action
HUD	Department of Housing and Urban Development	TITLE X	Title X of the Housing and Community Development Act of 1992, 42 U.S.C. 4822
IC	Institutional Control	TRW	EPA Technical Review Workgroup
ICP	Institutional Control Program	TSCA	Toxics Substances Control Act
		UAO	Unilateral Administrative Order

## 1.0 INTRODUCTION

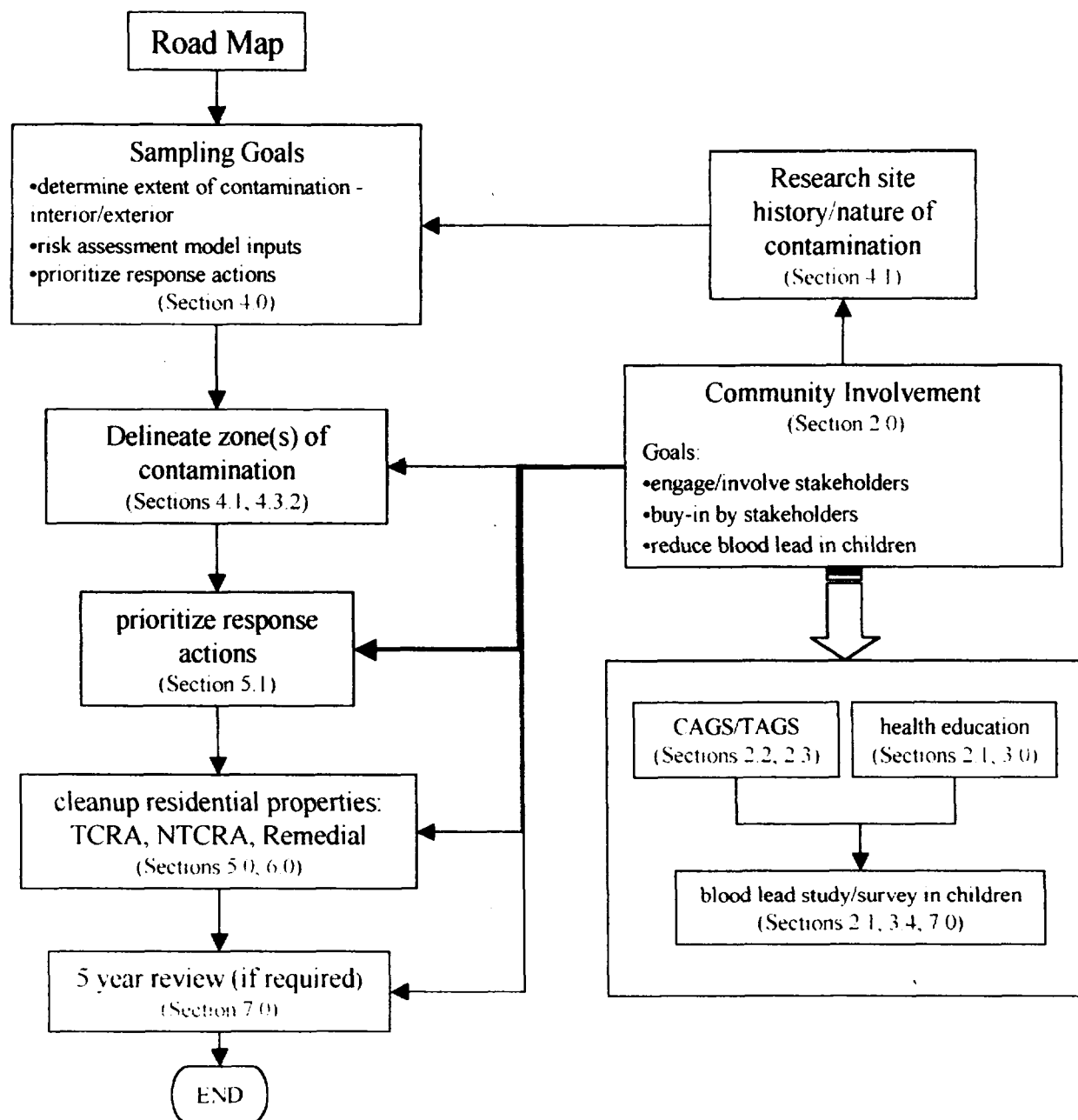
The Superfund Lead-Contaminated Residential Sites Handbook (subsequently called the Handbook) has been developed by the U.S. Environmental Protection Agency (EPA) to promote a nationally consistent decision-making process for assessing and managing risks associated with lead-contaminated residential sites across the country. The primary audience of this risk management document is Superfund Remedial Project Managers (RPMs) and Resource Conservation and Recovery Act (RCRA) Corrective Action Managers working on the characterization and cleanup of lead-contaminated residential sites. This handbook is not intended to apply to lead-contaminated commercial or industrial properties, other non-residential areas, or sites with ecological risks; however, some of the concepts may be useful for such properties. Addressing lead-contaminated properties at federal facilities requires a different approach, and this handbook provides a special section (Section 8) on addressing this universe of sites.

This information was developed primarily for EPA staff, but may prove useful to others working on lead-contaminated residential sites, including states, other federal agencies, tribes, local governments, public interest groups, and private industry. The Handbook lays out only the minimum considerations for addressing lead-contaminated residential sites and encourages users to refer to appropriate agency guidance and/or policy to conduct more stringent investigation and cleanup activities on a site-specific basis, if necessary. At a minimum, the site manager should determine the Applicable or Relevant and Appropriate Requirements (ARARs), such as state and local government laws and regulations, that apply to the site. It should also be noted that this handbook does not, outside the federal facilities universe, apply to lead-contaminated residential sites addressed under Title X (Housing and Community Development Act of 1992, U.S.C. 4822) procedures.

Lead site characterization and cleanup procedures are unique owing to the ubiquitous nature of lead exposures and the reliance on blood-lead concentrations to describe lead exposure and toxicity. Lead risks are characterized by predicting blood-lead levels with computer models and guidance developed by EPA, which are available on the internet: <http://www.epa.gov/superfund/programs/lead/prods.htm>. Major improvements in the removal of lead from gasoline, paint, and food packaging have significantly reduced the incidence of severe lead poisoning. The results of this progress mean that most environmental sources of lead exposure are more likely to cause subtle adverse health effects, primarily behavioral and learning impairments.

An overview to the cleanup process is provided as Figure 1-1. Section numbers are provided in the figure to help the reader locate information within this document.

Figure 1-1. An Overview to the Cleanup Process



## **1.1 BACKGROUND**

Elevated blood-lead concentrations in young children in the United States are still prevalent in many areas. Major sources of lead contamination include mining and milling sites, primary and secondary smelters, battery manufacturing and recycling facilities, pesticide formulators, pesticide use in orchards, and paint manufacturers. Many of the source facilities are located near residential areas or have had residential areas develop around them. Fugitive emissions from the facilities have resulted in soil contamination in the yards of residences, which in turn can cause high blood-lead levels in children.

Although numerous sites of this type currently exist, EPA has remediated, or overseen the remediation of, many of these sites and surrounding residences. Many different cleanup methods have been implemented with varying degrees of success. This document is based on the lessons learned from EPA's experience in remediating residential lead sites. It is intended to promote consistency in the characterization and cleanup of lead-contaminated residential sites, while retaining the flexibility needed to respond to different sites and communities to ensure success of the remedy and provide long-term protection of human health. The document also provides guidance on addressing lead sources and media, which the Superfund does not usually remediate, such as lead-based paint and lead plumbing. It is anticipated that this information will be periodically updated as we strive to improve our ability to respond to environmental lead hazards.

## **1.2 GENERAL DISCUSSION ON PROGRAMS ADDRESSING LEAD SITES**

This section provides a general discussion on the federal programs addressing lead contaminated sites. The discussion is limited to pertinent sections of Title X and EPA's Toxics Substances Control Act (TSCA) IV Lead Program ~~and the~~. The Title X discussion is provided for informational purposes and is primarily applicable to federal facilities (Section 8.0). ~~It~~ also provides useful information for lead-based paint and dust sampling (Section 4.2.4).

### **1.2.1 Comprehensive Environmental Response Compensation and Liability Act (CERCLA)**

#### **1.2.1.1 Background**

Historically, the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) has been used as a tool to implement cleanup activities at a large number of sites across the country. CERCLA authorities have been used for cleanups ranging from the removal of drums of

hazardous substances from long-abandoned sites, to major privately funded cleanup actions at sites on the National Priorities List.

CERCLA applies any time there is a release or threatened release of: 1) a hazardous substance into the environment or 2) a pollutant or contaminant "which may present an imminent and substantial endangerment to the public health or welfare." (EPA, 2000a) The term "release" is defined broadly in the statute, including any type of discharging or leaking of substances into the environment. This also includes the abandonment of closed containers of hazardous substances and pollutants or contaminants.

The definition of hazardous substance is extremely broad, covering any "substances," "hazardous constituents," "hazardous wastes," "toxic pollutants," "imminently hazardous chemicals or mixtures," "hazardous air pollutants," etc., identified under other federal environmental laws, as well as any substance listed under Section 102 of CERCLA. The fact that a substance may be specifically excluded from coverage under one statute does not affect CERCLA's jurisdiction if that substance is listed under another statute or under Section 102 of CERCLA. A comprehensive list of these substances is provided in 40 CFR 302.4. In addition to general listings for "lead", "lead and compounds" and "lead compounds," the regulation lists fourteen other subcategories of lead.

Additionally, CERCLA is not media-specific. Thus, it may address releases to air, surface water, ground water, and soils. This multi-media aspect of CERCLA makes it possible to conduct environmental assessments and design cleanup projects that address site contaminants in a comprehensive way.

The Agency has pursued a number of CERCLA response actions involving lead-contaminated soil using the abatement authority under section 106 (which also requires a showing of imminent and substantial endangerment). CERCLA covers almost every constituent found at mining and mineral processing (primary lead and other metals smelters) sites. Exceptions include petroleum (that is not mixed with a hazardous substance) and responses to releases of a naturally occurring substance in its unaltered form. It should be noted, however, that the latter exception does not include any of the releases typically dealt with at mining sites, such as acid mine drainage, waste rock, or any ore exposed to the elements by man.

### **1.2.1.2 Response Authorities**

CERCLA's main strength is its response authorities. EPA can either use the Superfund to perform response (removal or remedial) activities (Section 104) or require private parties to perform such activities (Section 106). CERCLA gives EPA the flexibility to clean up sites based upon site-specific circumstances. EPA's cleanup decisions are based upon both risk assessment and consideration of

“applicable or relevant and appropriate requirements” (ARARs). As long as the jurisdictional prerequisites have been met, CERCLA gives EPA the ability to perform any activity necessary to protect public health and the environment.

There are potential limitations in CERCLA which may be relevant to lead contaminated sites. For example, Section 104(a)(3)(B) limits EPA’s ability to respond to releases within residential structures as follows – Section 104(a)(3):

“Limitations on Response. The President (EPA) shall not provide for removal or remedial action under this section in response to a release or threat of release . . . from products which are part of the structure of , and result in exposure within, residential buildings or business or community structures . . . ”

The above cited section of CERCLA limits EPA’s authority to respond to lead based paint inside a structure or house as laid out in Section 6.6.1 of this handbook. However as noted in Section 6.6.1 of the handbook, EPA has the authority to conduct response actions addressing soils contaminated by a release of lead contaminated paint chips from the exterior of homes to prevent recontamination of soils that have been remediated.

CERCLA provides EPA with the authority to perform "removal" actions, and "remedial" actions. Assessments evaluate contaminants of concern, exposure pathways, and potential receptors. The assessment process includes the review of all available information as well as sampling for any other necessary information. The process is broad in its application and is a powerful tool in evaluating environmental risks posed by a site. Removal actions can be performed on mining and mineral processing (primary lead and other metals smelters) sites of any size in an emergency situation (e.g., implementation can occur within hours) or over a long period of time. Removal actions are subject to limits on time (12 months) and money (\$2,000,000) under the statute; however, these limits are subject to broad exceptions. For example, the Agency has implemented removal actions costing in the tens of millions of dollars at mining and mineral processing (smelter) sites.

Remedial actions are typically long-term responses performed at those sites placed on the National Priorities List. Remedial actions may be performed at non-NPL sites only if they are privately financed. Remedial actions are not subject to the time or dollar limitations imposed on removal actions, but require a more detailed and formal decision process.

### **1.2.1.3 Applicable or Relevant and Appropriate Requirements (ARARs)**

Under Section 121(d) of CERCLA, remedial actions must comply with substantive provisions of federal environmental laws and more stringent, timely identified state environmental or facility siting laws. Removal actions must comply with ARARs also, but only to the extent practicable. "Applicable" requirements are those federal or state laws or regulations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. "Relevant and appropriate" requirements are not "applicable," but address problem or situations similar enough to those at the CERCLA site that their use is well suited to the site.

State requirements are not considered ARARs unless they are identified in a timely manner and are more stringent than federal requirements. The recently published TSCA §403 Soil Hazard Rule which establishes a soil-lead hazard of 400 ppm for bare soil in play areas and 1200 ppm for bare soil in non-play area portion of the yard should not be treated as an Applicable or Relevant and Appropriate Requirement (ARARs), "to be considered" or TBC, or media cleanup standard (MCS). As recognized in the TSCA §403 Rule, lead contamination at levels below the 400 ppm and 1200 ppm standards may pose serious health risk based upon a site-specific evaluation and may warrant timely response actions. Thus, the soil-lead hazard levels under TSCA §403 Rule should not be used to modify approaches to addressing Brownfields, RCRA sites, National Priorities List (NPL) sites, State Superfund sites, federal CERCLA removal actions and CERCLA non-NPL facilities.

EPA has published a manual outlining all potential federal ARARs that may be requirements at Superfund sites. Published in two parts, the manual is entitled *CERCLA Compliance with Other Laws Manual*, Part I, August 1988, and Part II, August 1989, and is available at EPA libraries.

## **1.2.2 Title X and EPA's Toxics Substances Control Act (TSCA) IV Lead Program**

### **1.2.2.1 Background**

The Housing and Community Development Act of 1992 (PL102-550) contained Title X the "Residential Lead-Based Paint Hazard Reduction Act of 1992" (HUD, 1992). Even though this was a U.S. Department of Housing and Urban Development (HUD) authorization bill, it established a series of requirements for EPA. Title X includes a new Title IV of the Toxics Substances Control Act (TSCA). The sections that address EPA alone have section numbers in the four hundred (400) series, such as Section 403, Health Based Standards, whereas the HUD portions have numbers in the one thousand

(1000) series, such as Section 1015, Task Force. There is one section, i.e., 1018, that Congress required both HUD and EPA to jointly issue a rule on disclosure.

### **1.2.2.2 Overview**

Title X addresses lead-based paint and lead-based paint hazards and requires EPA and HUD to issue regulations to address those items. Title X's emphasis is on actual hazards such as deteriorating paint, lead in dust, or lead in soil versus potential hazards such as intact paint. Generally, Title X does not require inspections, risk assessments, abatements of lead-based paint, or lead-based paint hazards. The exceptions are HUD program related actions (Section 1012) or when a Federal agency disposes of a property that will be used for residential purposes (Section 1013). However, if you choose to do an inspection, risk assessment, or abatement, Title X establishes certification requirements and work practice standards that must be followed. Title X requires disclosure at the time of sale or rental (Section 1018) and the provision of a brochure, *Protect Your Family from Lead in Your Home* (EPA, 1999a), before rehabilitation (Section 406b). State programs that are accepted by EPA take precedent over the federal program and may be more stringent than the requirements described below.

### **1.2.2.3 Scope of Title X**

Title X contains specific classes of structures that it regulates. The first category is "target housing", which is defined as "...any housing constructed prior to 1978 except housing for the elderly or persons with disabilities (unless any child who is less than 6 years of age resides or is expected to reside in such housing for the elderly or persons with disabilities) or any 0-bedroom dwelling."

The second category is "child occupied facilities", which is a class of public buildings that EPA felt should be regulated, such as target housing. "Child occupied facilities" are defined as "... a building or a portion of a building, constructed prior to 1978, visited regularly by the same child, 6 years of age or under, on at least two different days within any week (Sunday through Saturday period), provided that each day's visit lasts at least 3 hours and the combined weekly visit lasts at least 6 hours, and the combined annual visits last at least 60 hours. Child-occupied facilities may include, but are not limited to, day-care centers, preschools and kindergarten classrooms" (HUD, 1992).

As of December 2001 target housing and child occupied facilities are the only classes of structures for which EPA has issued final regulations.

### 1.2.2.4 More Information

Section 405 requires EPA to establish a Hot Line and Clearing House for lead. This has been done and the National Lead Information Center is at 1-(800)-424-LEAD. Additionally the EPA web site at [www.epa.gov/lead](http://www.epa.gov/lead) has all the rules, fact sheets, and guidance documents that OPPT has developed.

## 1.3 DEFINITION AND PURPOSE

For the purposes of this document, a residential property includes properties that contain single and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, day-care centers, playgrounds, parks, and green ways (EPA, 1996a, 1997a). This document defines sensitive populations as young children (those under 7 years of age, who are most vulnerable to lead poisoning) and pregnant women. Focus is put on children less than 7 years old because blood-lead levels typically peak in this age range (EPA, 1986, 1990a; CDC, 1991). Unfortunately, this age range is also when children are most vulnerable to adverse cognitive effects of lead (Rodier, 1995). Pregnant women are included due to the effects of lead on the fetus (Goyer, 1990; Graziano et al., 1990; Carbone et al., 1998). Other EPA guidance (EPA, 1995a, 2001b) and local zoning regulations should also be referred to prior to determining which properties will be treated as residential.

Lead-contaminated residential sites are defined, for the purposes of this document, as sites where lead is the primary contaminant of concern in residential soils. Generally, lead-contaminated sites contain other metals of concern, such as cadmium and arsenic. This document, while addressing primarily lead contamination, may also be appropriate for use in remediation of sites contaminated by other metals. Furthermore, residential properties are defined in the Handbook as any area with high accessibility to sensitive populations, and includes properties containing single- and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, day-care centers, playgrounds, and parks. In all cases, looking at the site history (type of lead site, depositional environment for the lead contamination, fill activities, previous epidemiological studies, etc.) is important in the application of the Handbook. Typically, the types of sites addressed by the Handbook are sites where the lead contamination has resulted primarily from primary or secondary lead smelting, battery cracking, or mining and milling operations. Lead paint and dust, along with other sources of lead and other toxic metals, may also be present at these sites.

The Handbook is primarily based on a compilation of the Superfund program knowledge and experiences, as well as existing technical and scientific literature addressing lead-contaminated residential sites. The Handbook has undergone broad review by the Agency for Toxic Substances and Disease Registry (ATSDR), the Association of State and Territorial Solid Waste Management Officials

(ASTSWMO), ~~Department of Defense (DOD)~~, and national and regional EPA offices. Because the Handbook is written for use by CERCLA program staff, there are frequent references to guidance or other documents developed under the Superfund auspices. The Handbook does not supercede or modify any existing EPA guidance or policy. This does not suggest that CERCLA authorities are to be applied at all lead-contaminated residential sites. Rather, these references are provided to the reader as resources to be considered in developing site characterization and cleanup strategies under whatever regulatory or non-regulatory approach is appropriate at a particular site. The Handbook does not address ecological risks from lead and lead sites.

## **2.0 COMMUNITY INVOLVEMENT**

The sustainability of a residential cleanup project is contingent upon support from affected residents, elected officials, local public health agencies, municipal and public works staff, state government personnel, and other stakeholders. No other type of site impacts more citizens of a community than large residential cleanup projects, with many projects exceeding a thousand homes and several thousand residents. If the residents recognize the risks posed to their community and feel involved in the decision-making process, they are more likely to accept the need for cleanup. House-to-house personal interaction with residents can be useful to learn their concerns (or lack of concerns) and can also be an effective part of educating the public regarding risks posed by the site. Likewise, without the support of local governments, portions, if not all, of the selected remedy may be more difficult to implement. Many remedies rely in part on health education and institutional controls as part of the actions taken to protect human health, both of which may rely on the active participation of local governments and health departments. The following sub-sections provide information on involving the community.

### **2.1 EDUCATION ACTIVITIES**

This section discusses how to involve the local health departments and community in the education activities and the overall benefits and limitations of education. Section 3 addresses health education activities in detail.

Several studies have shown that a significant short-term reduction in blood-lead concentrations can be achieved through the education of the public on the dangers of lead exposure and methods to limit exposure (Kimbrough et al., 1994; Hilts et al., 1998; Schultz et al., 1999). However, EPA does not consider health education, as the only action, to be an effective, permanent remedy for Superfund sites (EPA, 1998b). Often, in-home education activities have been combined with regular house cleanings. One key to begin reduction of elevated blood-lead concentrations in children is to initiate health education activities, and where appropriate, blood lead screening, as early as possible in the process. These activities should be started as soon as elevated blood-lead levels or elevated soil levels are detected at a site. Education should be sustained throughout the project. If residual contamination, such as encapsulated wastes, lead-based paint, or other such potential sources are left on site after completion of the remedy, then education activities must be sustained in perpetuity.

Generally, EPA does not directly conduct the majority of education activities. The role of the project manager is to educate the community on the risks of lead exposure, and to establish the need for education programs. These programs are often implemented by local health districts who must, in turn, coordinate with schools and other community groups working with families and children. Initial tasks include educating the community regarding their lead exposure and associated health risks. Typically, a significant amount of effort will be required to explain the rationale and procedures of the EPA risk assessment method for lead, using the Integrated Exposure Uptake Biokinetic Model (IEUBK), and the need to collect data to estimate site-specific values for model parameters. It is advisable to obtain input on exposure parameters specific to the community (e.g., how often they frequent locations that are not residential). Community input into the risk assessment is not relevant to those parameters that require site-specific studies to generate empirical data (e.g., an animal feeding study to determine bioavailability). Often, local health officials will be unfamiliar with EPA's risk assessment process and will benefit from education along with the general public. The need for community education is heightened by the subtle nature of the low-dose adverse health effects of lead, which cannot be diagnosed in an individual because the scientific basis for cognitive impairments caused by low to moderate exposures relies on carefully controlled comparisons of large numbers of children exhibiting a range of blood lead levels (NRC, 1993; Needleman and Bellinger, 2001). Once the public and local health officials are made aware of the risks presented by the site, specific programs, discussed in detail in Section 4 (Health Education), can be implemented. Education and cleanup activities will be easier to implement, more effective, and more widely accepted by the community when the citizens understand the risks and that the community is at risk.

Integrated Exposure Uptake Biokinetic Model (IEUBK) – Predicts blood-lead concentrations (PbBs) for an individual child, or group of similarly exposed children (6 months to 7 years old), who are exposed to lead in the environment. More information is available from the Technical Review Workgroup for Lead (TRW) web site:

<http://www.epa.gov/superfund/programs/lead/ieubk.htm>

## 2.2 COMMUNITY ADVISORY GROUPS

Community Advisory Groups (CAGs) can be invaluable in assuring the success of the project (EPA, 1995b). A supporting and active CAG, comprised of a wide cross section of the community has been demonstrated on several projects to greatly contribute to the success of meeting the remedial goal by increasing satisfaction in the community at the completion of the project. Concurrent with the establishment of health education activities, formation of citizens groups

Community Advisory Group (CAG) – Members of the community make up a CAG, which serves as the focal point for the exchange of information among the local community, EPA, the State regulatory agency, and other pertinent Federal agencies involved in cleanup of the Superfund site. Additional information is available online: <http://www.epa.gov/superfund/tools/cag/resource/guidance/index.htm>

should be encouraged at the very onset of the project. Delay in forming the groups until significant progress has occurred may lead to mistrust by the community, as well as delay or loss of the valuable contributions they can make in assisting EPA.

Citizens groups should be representative of the community. Examples include residents, workers, and business owners from affected neighborhoods, as well as minority leaders, realtors, bankers or lending institution officers, school board members, health officials, elected officials, city public works staff, local environmental group members, and other groups in the community. Additionally, the project manager should coordinate with other federal and state agencies to attend citizen group meetings. Relevant agencies may include the ATSDR, the Department of Housing and Urban Development (HUD), and state health and environmental departments.

Citizens groups can create a feeling of ownership that facilitates the long-term success of the remedy. They can contribute significantly to education activities in numerous ways. A few examples of the successful programs and activities accomplished by citizens groups at sites include: general education and awareness of the segment of the community they individually represent; creating site-specific education material such as coloring/story books; hosting health fairs; creating health education programs for local school districts; establishing lead poisoning prevention merit badges for girl and boy scout organizations; developing instructional videos, and establishing pre- and postnatal education programs at local hospitals.

### **2.3 EPA'S TECHNICAL ASSISTANCE GRANT PROGRAM**

EPA provides technical assistance to communities to help citizens understand site-related information. By law, EPA must inform communities about the availability of Technical Assistance Grants (TAGs) and assist them in applying for these grants (EPA, 1992). EPA also informs citizens about obtaining assistance through other programs such as the university-based Technical Outreach Services for Communities (TOSC) program and the Department of Defense's Technical Assistance for Public Participation (TAPP) program.

Under the TAG program, initial grants of up to \$50,000 are available to qualified groups affected by a response action. Additional funding is available for unusually large or complex sites. A group applying for a TAG must be nonprofit and incorporated or working toward incorporation.

The group must contribute 20 percent of the total project costs to be supported by TAG funds. This requirement can be met with cash, donated supplies, and volunteered services. TAG groups must prepare

a plan for using the funds. There may be only one TAG award per NPL site. If more than one group applies for the same TAG, they are encouraged to form a coalition to apply for the grant.

TAGs can be used to hire a technical advisor, who is an independent expert that can review site-related documents, interpret them, and explain technical information to community members. A TAG advisor will often make site visits to gain a better understanding of the cleanup activities. A technical advisor can also help communicate the community's concerns to EPA. TAG funds may not be used to develop new information (e.g., to conduct additional sampling) or to underwrite legal actions. For further information on TAGs, see the Superfund TAG Handbook (EPA, 1994a).

## **2.4 INFORMATIONAL MEETINGS**

As important as the health education activities and establishment of citizens groups are, the project manager should consider holding frequent public meetings to inform the community of current and planned EPA activities and to collect feed back and concerns from citizens. If a CAG has been formed at the site, meetings with the group should be frequent and open to the general public. It is recommended that in the early phases of the project, public meetings should be held at least monthly. Once the community becomes aware of the site risks, current site activities, and becomes relatively involved in the process, the frequency of the meetings can be reduced. However, it is recommended that public informational meetings, separate from the citizens task force meetings, be conducted at least once every six months. This frequency can help ensure that the public stays informed of site progress and has an opportunity to provide meaningful input to the process.

In addition to the meetings required by CERCLA (e.g., prior to release of the Record of Decision), meetings should be held (at a minimum) at the following points in the process: (1) before sampling is conducted, to explain the reason that lead contamination is suspected, how residents can reduce exposure as a safety precaution while awaiting sampling results, and the overall goals of the project (e.g., if the goal of the project is to reduce exposure by remediating only surface soils and therefore the sampling is designed to evaluate only surface soils, the issue of institutional controls for any contaminated soils remaining at depth should be discussed with the property owners early in the process); (2) after sampling is conducted, to explain results, reiterate how residents can reduce exposure (if results show elevated levels), explain plans and the schedule for conducting remediation, discuss plans for re-landscaping the property, and discuss what sort of institutional controls will be necessary; and (3) after remediation is completed, to explain what was done, provide documentation of the results of the remediation, discuss any problems with the landscaping, and discuss any institutional controls necessary.

## 2.5 COMMUNITY INVOLVEMENT SPECIALIST

When the site is large and cleanup is expected to last several years, consideration should be given to housing a full time community involvement specialist (CIS) at the site. This person could be an EPA employee or state employee, or could be hired from the community to fill the position. The roles of the CIS are (1) to coordinate community involvement activities, and (2) to be readily accessible to the public to provide information and answer questions concerning site activities. The CIS should be intimately familiar with all activities at the site, as well as the documented health risks, and should maintain an office with business hours convenient to the public. Additionally, the CIS can use information gained from their constant contact with the local community to brief project staff on issues important to the successful remediation of the site.

**Community Involvement Specialist/Coordinator** - is the primary point of contact for a community and a Community Advisory Group (CAG), if one was formed for the site. He or she answers questions and provide other assistance directly as well as sees that CAG's concerns and other issues are transmitted to other Regional Office staff who can help.

### **3.0 HEALTH EDUCATION**

Health education provides information to the public about the risks associated with exposure to contamination and, in turn, how to reduce the exposures. Health education may be considered one of many tools the project manager can use at contaminated lead sites to reduce exposure to humans.

#### **3.1 APPROPRIATE USES FOR HEALTH EDUCATION**

Health education is an informational device and this type of instrument is largely unenforceable. Furthermore, health education has not been demonstrated to be effective over the longer term. Health education may be effective when combined with other measures as an overall remedy for a site. Health education is not a stand-alone remedy. EPA's policy is that health education is only appropriate as a supplemental component of the final permanent and health protective remedy selected at a contaminated lead site.

For these reasons, EPA advocates that health education be layered or implemented in series with institutional controls (ICs) and engineered remedies. Layering means using different types of ICs and engineered remedies at the same time to enhance the protectiveness of the remedy. Using ICs in series is the use of ICs at different points in the investigation and remediation process to ensure the short- and long-term protection of human health and the environment.

#### **3.2 PLANNING FOR HEALTH EDUCATION**

Generally, the specific goals of the health education program should be described in a site-specific decision document. A plan that clearly defines the goals and how they should be achieved is also more likely to succeed. Health education at large lead sites may have a performance period of several years and cost hundreds of thousands of dollars. For these large projects, a clearly defined health education program is even more essential.

An early step in any health education planning process includes conducting a community profile and assessing the educational needs of the community. A comprehensive health education program for a typical large lead site would normally attempt to focus on reaching the general public, with special emphasis on schools and other groups involved with young children. Also, it is essential to coordinate with city, county, and other local governmental entities. The most important target population, though, are parents, particularly young parents, and parents with a child whose blood lead tested high. Other means of targeted education may include those homes with children that have high dust lead concentrations or lead

loadings, which have been shown to be highly predictive of homes where a child is likely to have an elevated blood-lead level during the summer peak (EPA, 1996b; von Lindern and Spalinger, 2001).

The response plan should describe what actions and activities are necessary to reach the community-at-large and the targeted groups. It is very important to consider that there are costs associated with the development, implementation, and follow up of health education and that these factors should be thoroughly understood and estimated. Other key points to consider are that the responsibilities for conducting this work should be clear and agreements should be made in writing in the planning stages of site response process.

### **3.3 EVALUATION OF HEALTH EDUCATION ACTIVITIES**

It is important to monitor the effectiveness of health education projects that have been implemented at lead-contaminated sites. Many sites may include health education activities as a major component of the remedy, especially in the early phases of the cleanup. Failure to establish the education part of the remedy may trigger reconsideration and imposition of additional requirements, or more extensive and costly cleanup efforts.

The project manager should monitor the organization(s) performing the educational activities for proper implementation of the health education program and assess the effectiveness of the program. Project managers should ensure that the objectives of the program are being met to protect children's health. If health education is included as part of the final remedy, it should be carefully scrutinized during the Five-Year Review process.

### **3.4 AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY (ATSDR) INVOLVEMENT**

Health education is often implemented through grants from the ATSDR to their partners in state health departments or directly through agreements with local health departments. When health education is specified as a major part of EPA's cleanup activities, strong consideration should be given to establishing an interagency agreement with ATSDR to assist in funding the required activities. ATSDR as a federal health agency is well positioned in terms of health education resources to administer such grants. ATSDR can provide expertise not only with the CAGs but also with public health assessments, health consultations, and health surveillance. An emphasis should be placed on developing the collaborative partnerships between EPA, ATSDR, and other federal, state, and local health departments for health education activities at contaminated lead sites.

Health education at lead sites is often accompanied with blood lead screening. Centers for Disease Control and Prevention (CDC) has issued guidelines for increasing intensity of health intervention activities based on blood lead test results (CDC, 1991). Increased collaboration among the involved agencies is essential to properly implement a health education/blood-lead screening project. Additionally, ATSDR and many state and local health departments have ongoing lead screening and health education programs. Information from targeted screening is valuable for (1) targeting follow-up education to individual families with children identified with elevated blood lead levels; (2) determining the areal and demographic extent of the problem; and, (3) effectively evaluating the impact of health education.

### **3.5 OUTREACH**

EPA has had success in health education activities at several sites because of the programs tailored specifically for the site by the site team. These programs have always included significant amounts of outreach activities in the communities. The success of any health education program can be attributed to the amount of community outreach that is conducted at the site. As discussed in Section 2, the outreach can consist of a wide variety of activities. A few examples include the following: site specific coloring books distributed to the parents of young children, scouting merit badges on lead-poisoning prevention, school curriculums developed to inform student of the hazards of lead and good hygiene, health and environmental fairs conducted in the community, and blood-lead testing events held at community celebrations. Consultation with local health officials and community groups can provide numerous ideas for outreach, which can be incorporated into specific programs to best meet the needs of the community. Typically, the local health officials should lead the outreach efforts. Funding should be provided by EPA when other funds, such as from ATSDR, are unavailable to support the outreach activities.

## **4.0 SITE CHARACTERIZATION**

EPA has reviewed various sampling designs historically employed at residential lead-contaminated residential sites and assessed the ability of these sampling designs to meet risk assessment needs and eventually select cleanup numbers. Over a 20-year period, several large area lead sites (e.g., Bunker Hill, Shoshone County, Idaho; Joplin, Missouri; NL Industries/Taracorp-Granite City, Illinois; Tar Creek, Ottawa County, Oklahoma) have used a variety of sampling techniques to characterize residential properties. Additionally, many different approaches to applying selected cleanup numbers have been taken. As stated, this document was developed to promote consistent procedures, criteria and goals in the investigation and cleanup activities at Superfund and RCRA lead-contaminated residential sites. However, a level of flexibility is needed to best respond to different site conditions, communities, and uncertainties.

The overall goal of the sampling effort is to estimate an average soil lead concentration for risk assessment purposes. This information can also be used for public education and intervention. The sampling designs discussed in this section are intended to provide, within one sampling effort, the necessary data for all phases of a cleanup project so that residents are not inconvenienced by repeated sampling of the same property. Although additional sampling points may be desirable to further refine the average lead level for a property and adjacent areas, there is also a need to balance the cost of the yard sampling effort versus the cost of yard remediation. Therefore, some uncertainty is accepted to reduce the overall cost of sampling and remediation. The selection of sample locations and spacing within areas with potential for exposure has been the subject of recent articles which describe methods to manage decision uncertainty by balancing sampling and cleanup costs (Englund & Heravi, 1994; Crumblin et al., 2001). Table B-1 (Appendix B) lists contacts within the agency who can provide assistance in various aspects of sample planning and design, and also lists software that may be used for sample planning and decision support.

Section 4.0 discusses: (1) delineating the contamination zones; (2) residential property sampling locations; (3) sampling method; (4) additional information regarding contacts and software for sample design; and (5) sampling requirements for backfill material and excavated soil for off-site disposal.

### **4.1 CONTAMINANT ZONE DELINEATION**

Historical information on site operations and use is crucial for the design of sampling plans that are intended to delineate contaminant zone(s), and for the interpretation of data generated from the sampling effort. In addition to gathering data on the nature of the source of contamination, information should be gathered to identify areas where soils may have been moved or where fill or topsoil may have been placed. Guidance on how to gather historical site data is available (EPA, 2001f, 2001g). Sites that have been

contaminated primarily by airborne-derived lead, such as smelter areas, can initially be sampled in a grid pattern. This will usually allow concentration contours to be defined across the community to establish the extent of horizontal contamination for cleanup and costing purposes. If grid sampling is used for initial characterization to define the horizontal extent of contamination, follow-up sampling of each yard located within the identified cleanup zone is required to characterize each individual property for cleanup requirements. For other sites where the variability is expected to be higher, such as mining sites with discrete individual tailings piles located throughout the area, delineating the contaminant zones by establishing concentration contours will be more uncertain and consideration should be given to sampling every home in the potentially affected area, moving laterally away from the source until clean areas of the community have been identified.

Delineating the zone of contamination amounts to distinguishing soil with "background" lead concentration from soil that has been impacted by site-related activities. There are basically two types of background: naturally occurring and anthropogenic (see insert for definitions) (EPA, 1989). EPA guidance defines background for inorganics as *"...the concentration of inorganics found in soils or sediments surrounding a waste site, but which are not influenced by site activities or releases"* (EPA, 1995c). Natural background concentrations of lead vary widely with the local geology, and can be as high as 250 ppm or more in mining areas (SRC, 1999). Local background concentrations, which include natural and non-site-related anthropogenic sources (e.g., historic automobile emissions), can be substantially higher. Background samples should be collected from areas near the site that are not influenced by site contamination, but that have the same basic characteristics (e.g., soil type; land use).

#### Types of Background

naturally occurring: ambient concentrations of lead present in the environment that have not been influenced by humans

anthropogenic: lead concentrations that are present in the environment due to human-made, non-site sources (e.g., automobiles).

Statistical approaches to delineating contaminant zones are useful for some sites. In these cases, the RPM should consult with a statistician to design an effective sampling plan for background soil sampling. Geostatistics is widely recognized for offering graphical methods that are ideally suited for delineating contaminant zones (Gilbert and Simpson, 1983; Flatman and Yfantis, 1984; Journel, 1984; Englund and Heravi, 1994; Goovaerts, 1997). Geostatistics also provides powerful methods for detecting contaminated areas from background when sample locations have not been randomly selected (Quimby, 1986; Borgman and Quimby, 1996), for sampling plan design (Flatman and Yfantis, 1984; Borgman, et al., 1996) and for aiding in the design of remedial responses (Ryti, 1993). For smaller sites, rigorous statistical analyses may

be unnecessary because site-related and non site-related contamination clearly differ. For these sites, the sampling plan should focus on establishing a reliable representation of the extent (in two or three dimensions) of a contaminated area (EPA, 1989) .

## **4.2 RESIDENTIAL PROPERTIES**

In this document, a residential property includes properties that contain single and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, day-care centers, playgrounds, parks, and green ways (EPA, 1996a, 1997a). In all cases, historical site information (type of lead site, fill activities, previous epidemiological studies, etc.) is important in the application of this handbook.

Rationale for collecting yard soil samples and water samples on a residential property is provided in Table 4-1.

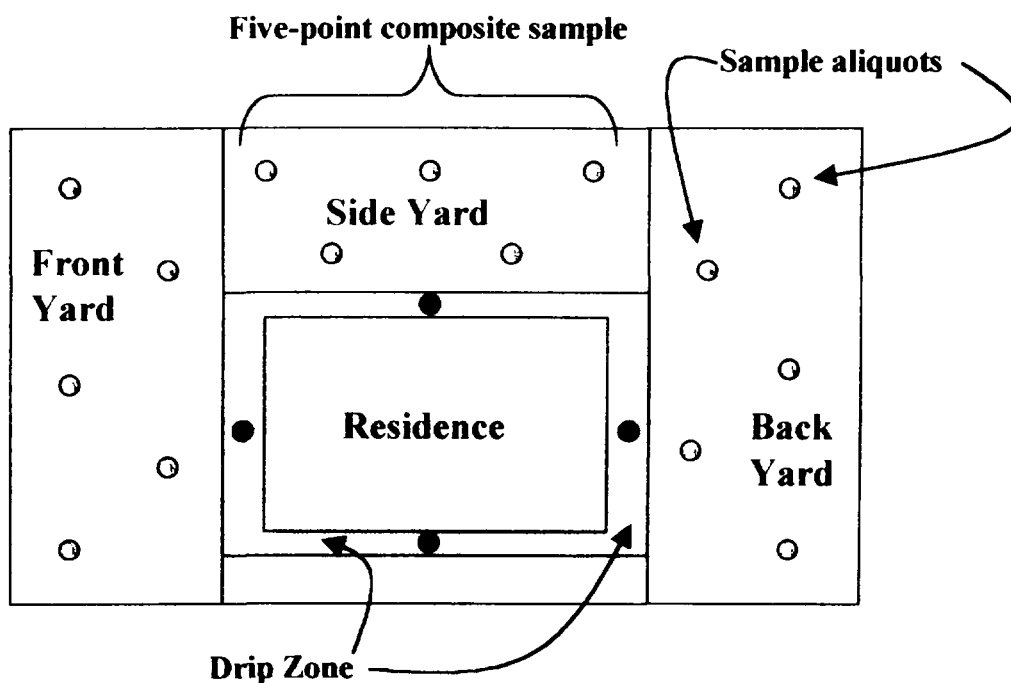
### **4.2.1 Residential Yards**

It is recommended that when sampling residential lots with a total surface area less than 5,000 square feet, five-point composite samples should, at a minimum, be collected from each of the following locations: the front yard, the back yard, and the side yard (if the latter is of significant size). The front, back, and side (if needed) yard composites should be equally spaced within the respective portion of the yard, and should be outside of the drip zone and away from influences of any other painted surfaces (Figures 4-1a and 4-1b). Composites should consist of aliquots collected from the same depth interval.

**Table 4-1.  
Rationale for Sampling Residential Properties**

Sample Location	Rationale for Sample Collection
Residential yard soils	Residential soil may present a direct exposure pathway to persons working, playing, or conducting other recreational activities on the property. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations. Residential soils may also present an indirect exposure pathway via house dust exposure (see below).
Gravel driveways	Fine-grained driveway material may present a direct exposure pathway to persons working or engaged in recreational activities on driveways. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations. Gravel driveways with elevated soil concentrations may also contribute to tracking of contaminants throughout the community.
Soils below roof gutter downspouts	Rooftops may collect fine-grained sediments that contain high concentrations of lead. In yard areas where downspouts discharge during a storm event, the fine-grained material washed from a roof may accumulate and result in a localized increase in soil lead concentrations. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations. Drip zone areas may also contain lead-based paint influences and are important to characterize for health intervention purposes, as drip zones are often used as play areas.
Soils in play areas	Play area soils may present a direct exposure pathway to children under the age of seven. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations.
Garden soils	Garden soils may present a direct exposure pathway to persons who actively maintain a garden. Soil samples should be collected and quantitatively analyzed to estimate lead concentrations.
Interior lead dust	Lead in household dust may be a significant contributor to elevated blood-lead levels, especially in younger children. Dust samples should be collected and quantitatively analyzed to estimate lead concentrations. Lead-contaminated interior dust can be derived from multiple sources; dust mat samples and speciation can be used to identify lead sources.
Lead-based paint	Deteriorating lead-based paint may contribute lead to household dust, which can be a significant source of lead exposure, particularly for young children. If elevated concentrations of lead are found in interior dust, samples of interior paint should be collected and quantitatively analyzed to estimate lead concentrations. Exterior lead-based paint may contribute to the recontamination of remediated properties. Samples of exterior lead-based paint should be collected and quantitatively analyzed to estimate lead concentrations.
First run and purged tap water	Groundwater and surface water near the site may contain elevated lead concentrations. Some residences located within the site may use local groundwater or nearby surface water as a source of drinking, cooking, bathing, or irrigation water. The water may represent a direct exposure or ingestion pathway. Samples of both water standing in the pipes (first run sample) and water discharged after the system has been flushed (purged sample) should be collected and quantitatively analyzed to estimate lead concentrations. These results can also be used to help determine if the drinking water is contaminated with site-related contamination (exceedance in purged), or to determine if there is lead in the home's plumbing (exceedance in first run), or both, which may be used for remediation or intervention purposes, respectively.
Other areas	During field work, other potential sources of lead contamination may be identified. If the sources appear to represent a potential exposure pathway to occupants of a residence, sampling may be recommended. Other areas should be evaluated on a case-by-case basis and could include sediment, surface water, or secondary play areas. If deemed appropriate, samples should be collected and quantitatively analyzed to estimate lead concentrations.





**Figure 4-1b.** Recommended minimum soil sampling in yards less than or equal to 5,000 square feet with significant side yard. Five point composite samples should be collected from each of the front, back and side yards, along with other areas as described in Figure 4-1a. The locations of the aliquots should be equally spaced within the area of the yard the composite is collected from. The figure illustrates one possible arrangement of the sample aliquots. Aliquots for a single composite sample should be collected from the same depth interval. Please refer to Section 6.2.1 for further explanation.

For residential lots with a total surface area greater than 5,000 square feet, it is advisable that the property be divided into four quadrants of roughly equal surface area. The two quadrants in the front yard should encompass one half of the side yard; likewise for the two quadrants in the back yard. One five-point composite of aliquots collected at equal spacing and depth interval should be obtained from each quadrant. Each aliquot should be collected away from influences of the drip zone and any other painted surfaces (Figure 4-2).

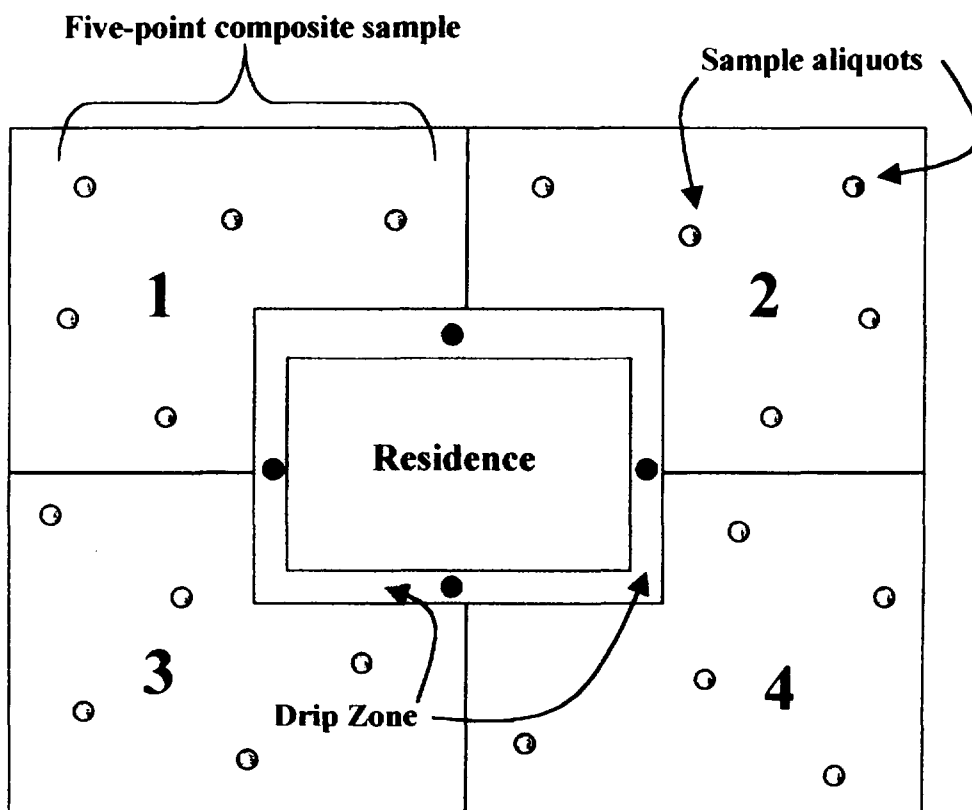
Properties over one acre in size should be divided into 1/4 acre sections. One five-point composite sample should be collected from each section. For large properties, consideration should be given to whether elevated concentrations trigger partial removal of soils or access restriction (see Section 6.5).

#### **4.2.2 Drip Zones**

Lead-contaminated soils are frequently found within the drip zone of houses. It is recommended that a four-point composite sample be collected from the drip zone of each residential property (Figures 4-1a, 4-1b, and 4-2). The composite sample (taken from any size lot) should consist of a minimum of four aliquots collected between 6 and 30 inches from the exterior wall of each house. Each aliquot should generally be collected from the midpoint of each side of the house. Collection of additional aliquots should be considered if other factors exist, such as bare spots, distinct differences in the house exterior, and areas where runoff collects.

#### **4.2.3 Play Areas, Gardens, and Driveways**

Distinct play areas and gardens, if present, should generally be sampled separately as discrete areas of the yard. At some sites, collection of a right-of-way/easement composite may also be appropriate, such as residential areas with unpaved streets and alleys. Paved surfaces such as asphalt/concrete driveways, patios, alleys, and parking lots should, in most cases, not be sampled. Samples should also be collected in other locations depending upon the potential for exposure or recontamination; for example, under porches and crawl spaces and areas with incomplete barriers such as gravel driveways.



**Figure 4-2.** Recommended minimum soil sampling in yards greater than 5,000 square feet. Five point composite samples should be collected from each of the four quadrants as indicated above. The locations of the aliquots should be equally spaced within the area of the yard the composite is collected from. The figure illustrates one possible arrangement of the sample aliquots. Four point composites should be collected from the drip zone; each aliquot should generally be collected from the midpoint along each side of the residence. Aliquots for a single composite sample should be collected from the same depth interval. Additional samples should be collected from distinct play areas and gardens if they are present, as well as unpaved driveways and minimal use areas such as areas under porches and crawl spaces. Please refer to Section 4.2.1 for further explanation.

#### **4.2.4 Potable Water, Lead-Based Paint and Interior Dust**

Samples of potable water should be collected to determine if exposure to the lead in drinking water is occurring. First run and purged samples of potable water should be collected to differentiate site-related sources of lead from lead derived from plumbing that is located within the residence. Deteriorating lead-based paint may contribute lead to household dust. If elevated concentrations of lead are found in interior dust, samples of interior paint should be collected. Exterior lead-based paint may contribute to the recontamination of remediated properties (Section 6.7). Samples of exterior lead-based paint should be collected and analyzed to estimate lead concentrations. Lead in household dust may be a significant contributor to elevated blood-lead levels, especially in younger children. Lead-contaminated interior dust can be derived from multiple sources; dust mat samples and speciation can be used to identify lead sources. Guidance on lead-based paint and dust sampling is available from HUD (HUD, 1995).

#### **4.2.5 Backfill and Waste Soil**

Backfill soil should be sampled to ensure that uncontaminated material is being placed on the site. The list of analytes and the frequency of sampling should be based on site-specific factors including the location of the source for the backfill material relative to potential sources of contamination, the geology of the borrow area, and the heterogeneity of the material. For example, on the Bunker Hill Superfund Site, four-point composite samples are required for each 200 yd<sup>3</sup> of soil (TerraGraphics, 1997a). Gravel for driveway backfill is also sampled every 200 yd<sup>3</sup> (TerraGraphics, 1997b). Samples of excavated soil should be sampled by the TCLP method to determine the appropriate method of disposal. The frequency required for TCLP sampling should be based on the heterogeneity of the lead and other contaminant(s), if any, on the site, and ARARs.

### **4.3 SAMPLING METHOD AND ANALYSIS**

#### **4.3.1 Sample Collection**

Composite samples should consist of obtaining discrete aliquots of equal amounts of soil. The soil from each aliquot should be collected into one clean container, such as a stainless steel bowl or plastic bag, and thoroughly mixed. After mixing, the sample can then be analyzed with the X-Ray Fluorescence (XRF) or sent to the laboratory. Remaining sample volume can then be disposed in the general location from where it was collected, or archived, depending on the requirements of the project. In some cases, material other than grass and/or soil will be encountered at a sample location, e.g., wood chips and sand are often found in recreational areas of day-care and school playgrounds. Samples of the soil below the cover material should be collected.

The use of a dynamic sampling and analysis strategy should be considered (EPA, 2001d). A dynamic sampling and analysis strategy takes full advantage of the real-time data field analytical methods provide, which can limit the sampling effort and minimize cost (EPA, 2001d). This document suggests the use of field portable X-Ray Fluorescence (FP-XRF) analysis.

#### **4.3.2 Sample Depth**

The following sampling design is based on the assumption that removal of surficial contaminated soils and placement of a cover of clean soil will be protective of human health and the environment (see Section 4.0). Furthermore, the sampling design outlined below is based on the assumption that a minimum of 12 inch soil cover is adequate.

Initial sampling for lead contamination in residential soils should be conducted to a depth of at least 18 inches, but does not need to exceed 24 inches to define the vertical extent of contamination for cleanup purposes. Composite samples should be collected at 6 inch depth intervals, i.e., 0–6 inches, 6–12 inches, 12–18 inches, and 18–24 inches. Additional sampling may be required at lead sites in cold weather regions with contamination associated with coarse grained material. Stone-sized material, such as tailings and crushed battery casings, will, over time, migrate upward through the soil via freeze/thaw effects. At such sites, composite sampling should be conducted at 6 inch intervals to the approximate maximum frost depth for the region. In all cases, composites should consist of aliquots collected from the same depth interval.

In site-specific situations, deeper sampling may be conducted to determine the total vertical extent of contamination for groundwater issues or institutional controls, and to determine if complete removal of contaminated soil is possible. Depth sampling should be conducted until the vertical extent of contamination has been adequately defined, but does not need to be conducted in every property.

In addition to the composite samples collected to define the vertical extent of contamination, five-point composite surface soil samples should be collected from zero to two centimeters (one inch) for human health risk assessment purposes (EPA, 1989, 1996c). The samples should be collected using the procedure described in Section 4.2.1. These surface soil samples should be collected from every property within the identified zone of contamination; however, after collecting a statistically valid number of both 0–1" and 1–6" samples, the project manager may want to compare both sample horizons (e.g., two sample t-test; Wilcoxon Rank Sum test) (Gilbert, 1987; Snedecor and Cochran, 1989) to determine if the 0–1" depth can be eliminated (i.e., sample from 0–6"), to further limit sampling costs. This may be particularly useful at mine waste sites where contamination often extends to depth or at sites where lead-contaminated soil has been used as fill material; in such cases, the lead concentration may increase with depth.

Conversely, the 0–1" horizon may be far more contaminated than the 1–6" at smelter sites, making individual horizon sampling crucial to remedial decision making.

Collection of samples from specified depth intervals serves to two primary goals, (1) risk assessment and (2) cleanup (i.e., remedial) decision-making. With respect to risk assessment, the top inch of soil best represents current exposure to contaminants (EPA, 1989, 1996c) and is the source of data used in the IEUBK model to represent exposure from soil. The various depth intervals are used in remedial decision making to determine if a residential yard requires cleanup by evaluating if any horizons exceed the site-specific action level. The lower soil horizons represent possible future exposures, such as homeowner projects, children's play areas, and other home activities that periodically go beneath the top inch of vegetation/soil (EPA, 1989). All soil horizons are used for cleanup decision-making. The six inch depth intervals recommended in this document are based on the performance that may be reasonably expected of operators of small equipment working in relatively small spaces around homes. Specifically, a "bobcat" is most efficiently used for soil removal on a property if the soil is removed in six inch intervals, rather than in smaller increments, which would be far more difficult to achieve in a consistent or cost-effective manner. This approach has been developed to ensure a residential yard is cleaned up if it poses an immediate or long-term risk to human health in a manner that relates the sampling methodology closely to reasonable and cost-effective construction equipment performance. A secondary goal of the sample collection effort is to facilitate the implementation of an institutional control program (ICP) for sites where contamination at depth is left in-place.

#### 4.3.3 Sample Preparation

Residential soil lead samples should represent the exposure potential of young children who are most vulnerable to adverse effects of exposure. Children typically inadvertently ingest lead in soil and dust which adheres to their hands (Succop et al., 1998). The smaller particles are more representative of this type of exposure (Duggan et al., 1985; Kissel et al.,

1996; Mielke et al., 1997). Additionally, smaller particles are preferentially brought into the home. Sieving is conducted to better represent the soil fraction that is ingested by the typical child. Sieving has also been used in soil ingestion and bioavailability studies (Calabrese et al., 1996; Casteel et al., 1997; Stanek et al., 1999). Samples

Technical Review Workgroup (TRW) – The TRW is an interoffice workgroup that consists of key scientific experts from various EPA regions, labs, and headquarters that supports and promotes consistent application of the best science in the field of lead (Pb) risk assessment at contaminated sites nationwide.

collected from all depth intervals should be sieved. Samples should not be ground prior to sieving, as this changes the physical structure of the soil which may bias the analytical results. To reduce sampling costs, it may be desirable to develop a correlation between sieved and unsieved data, to eliminate the need to

sieve all samples. The correlation can be used to predict sieved results from unsieved samples. The EPA Technical Review Workgroup (TRW) and American Society for Testing and Materials (ASTM) have issued guidance on sieving (ASTM, 1998; EPA, 2000b). The EPA TRW guidance addresses appropriate sieve size and a method for predicting the concentration in the fine fraction using concentrations measured in unsieved samples.

HUD guidelines state that "If paint chips are present in the soil, they should be included as part of the sample. However, there should be no special attempt to over-sample paint chips. The laboratory should be instructed to disaggregate ('break up') paint chips by forcing them through a sieve in the laboratory. Although paint chips should not be excluded from the soil sample, since they are part of the soil matrix." (HUD, 1995). The TRW website should be checked periodically for additional sampling guidance.

#### **4.3.4 Sample Analysis**

EPA's experience in sample analyses at large residential contamination sites (with several thousand homes on a site) shows that both FP-XRF or fixed-site laboratory analyses (acid digestion/Inductively Coupled Spectroscopy, AD/ICP) provide reliable information (EPA, 1996d, 1998a, 2001c, 2001d; Crumblin et al., 2001). The objective of using a FP-XRF is to predict Contract Laboratory Program (CLP) values with less expensive real-time data. A sufficient amount of data must be collected to develop a site-specific relationship (i.e., correlation) between FP-XRF and CLP lab data.

The comparison should consider sample preparation (drying and sieving) and analytical methods. Typically, a large number of laboratory confirmation samples should be analyzed at the beginning of the project to estimate the correlation between the FP-XRF and the CLP results and the FP-XRF precision and accuracy. Additional confirmatory samples should then be analyzed at key decision points when the FP-XRF results are close to action levels or when the reliability of the FP-XRF unit is in question (EPA, 2001d). For example, initial sample analyses using an FP-XRF instrument could include 20 percent laboratory confirmation samples to assess the accuracy and precision of the FP-XRF. Once the accuracy and precision of the FP-XRF results have been determined (and assuming they satisfy the requirements of the project), laboratory confirmatory sampling could be reduced (e.g., to 5 percent). Additional information on analyzing soil (and other media) in the field with FP-XRF is available on the internet: <http://www.epa.gov/superfund/programs/dfa/> (EPA, 2001e).

Proper calibration of the FP-XRF unit is essential to obtaining reliable results (EPA, 1996d). Correlation between the FP-XRF and laboratory analyses is best achieved with smaller sample volume. Laboratory confirmatory samples should be collected in the specimen cup available from the FP-XRF.

manufacturer. The sample is first analyzed with the FP-XRF and then sent to the laboratory for wet chemistry analysis. Soil moisture can introduce error in FP-XRF results to varying degrees, depending on the instrument being used (EPA, 1996d). The correlation between the FP-XRF measurements on dried and undried samples should be estimated. The estimate correlation analysis should then be used to establish a cutoff or 'soil moisture ceiling'. The 'soil moisture ceiling' represents the maximum moisture content at which useful results (i.e., of sufficient precision and accuracy) can be obtained with the FP-XRF. Field portable instruments capable of measuring moisture content are available and should be used to compare sample moisture content to the 'soil moisture ceiling'. Samples with moisture contents greater than the 'soil moisture ceiling' should be dried prior to analysis with the FP-XRF.

## 5.0 CLEANUP LEVEL SELECTION

The approach to human health risk assessment for lead differs from that of other metals and contaminants. Typically, risk from lead exposures are estimated from long-term exposures, although elevated blood-lead concentrations also result from short term exposures (CDC, 1991). EPA has developed the IEUBK model to assess blood lead (PbB) concentrations in children exposed to lead. The model considers several different media through which children can be exposed to lead.

EPA and the CDC have determined that childhood PbB concentrations at or above 10 micrograms of Pb per deciliter of blood ( $\mu\text{gPb/dL}$ ) present risks to children's health. Accordingly, EPA seeks to limit the risk that children will have Pb concentrations above 10  $\mu\text{gPb/dL}$ . The IEUBK model calculates the geometric mean PbB for a child exposed to lead in various media (or a group of similarly exposed children). The model also calculates the probability that the child's PbB exceeds 10  $\mu\text{gPb/dL}$  ( $P_{10}$ ). Preliminary remediation goals (PRGs) are determined with the model by adjusting the soil concentration term until the  $P_{10}$  is below 5%. Final cleanup level selection for Superfund sites are based on the IEUBK model results and the nine criteria analysis per the National Contingency Plan (NCP) (EPA, 1990b), which includes an analysis of ARARs. More information on IEUBK model is available from the EPA TRW web site: <http://www.epa.gov/superfund/programs/lead/ieubk.htm>

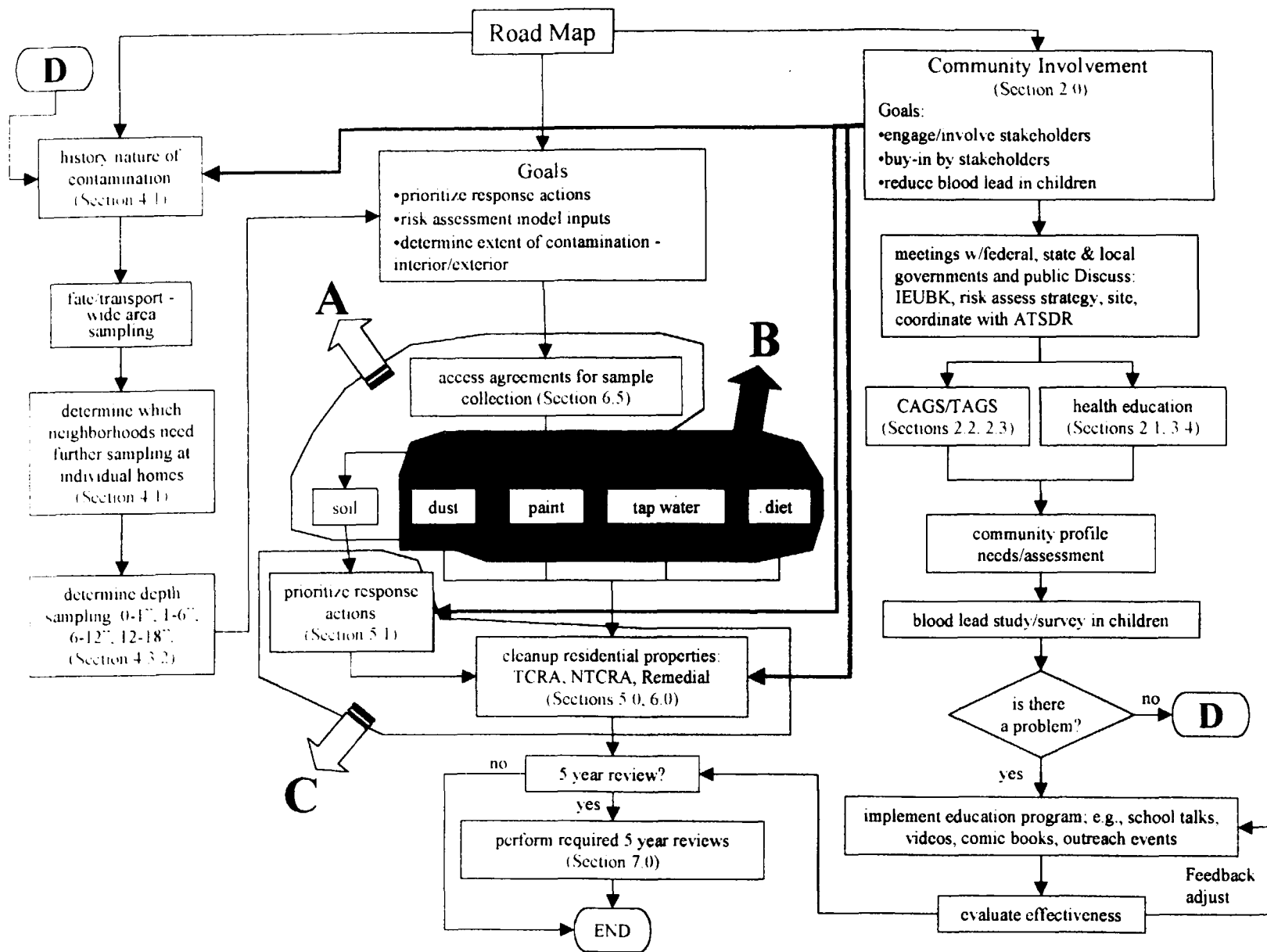
Typically at large lead sites, the early actions taken to mitigate the identified site risks consist of time-critical removal actions (TCRAs), most often taken as an interim action. These actions are usually followed by long-term remedial actions. The following sections describe the different approaches that should be used for selecting cleanup levels for both early (interim) and long-term (permanent) actions.

### 5.1 PRIORITIZING RESPONSE ACTIONS

For early, interim actions, a tiered approach should be used for prioritizing cleanup actions. A tiered-response approach is recommended when sufficient resources are not available to fully address lead risks. The size and complexity of many lead sites often requires implementation of response actions over an extended period of time; therefore, it is often necessary to implement interim cleanup actions to manage short-term health risk concerns while response actions to address long-term risk are planned and implemented. Early removal actions at residential lead sites should contribute to the performance of the long-term permanent remedy.

The tiered approach is depicted in Figure 5-1. Figure 5-1 is a flowchart that provides a roadmap of the recommended cleanup process for lead-contaminated residential sites. An overview to the cleanup

process is provided in Figure 1-1. The first page of Figure 5-1 provides a more detailed overview; the subsequent pages provide additional details of the process.



**Figure 5-1. Recommended cleanup process for lead-contaminated residential sites.** Refer to Figure 1-1 for an overview of the process. The shaded portions of the figure, labeled A-C, are expanded on the second through the fourth pages of the flowchart.

\* DRAFT - Do not cite or quote - Thursday, February 7, 2002 \*

Figure 5-1. (continued)

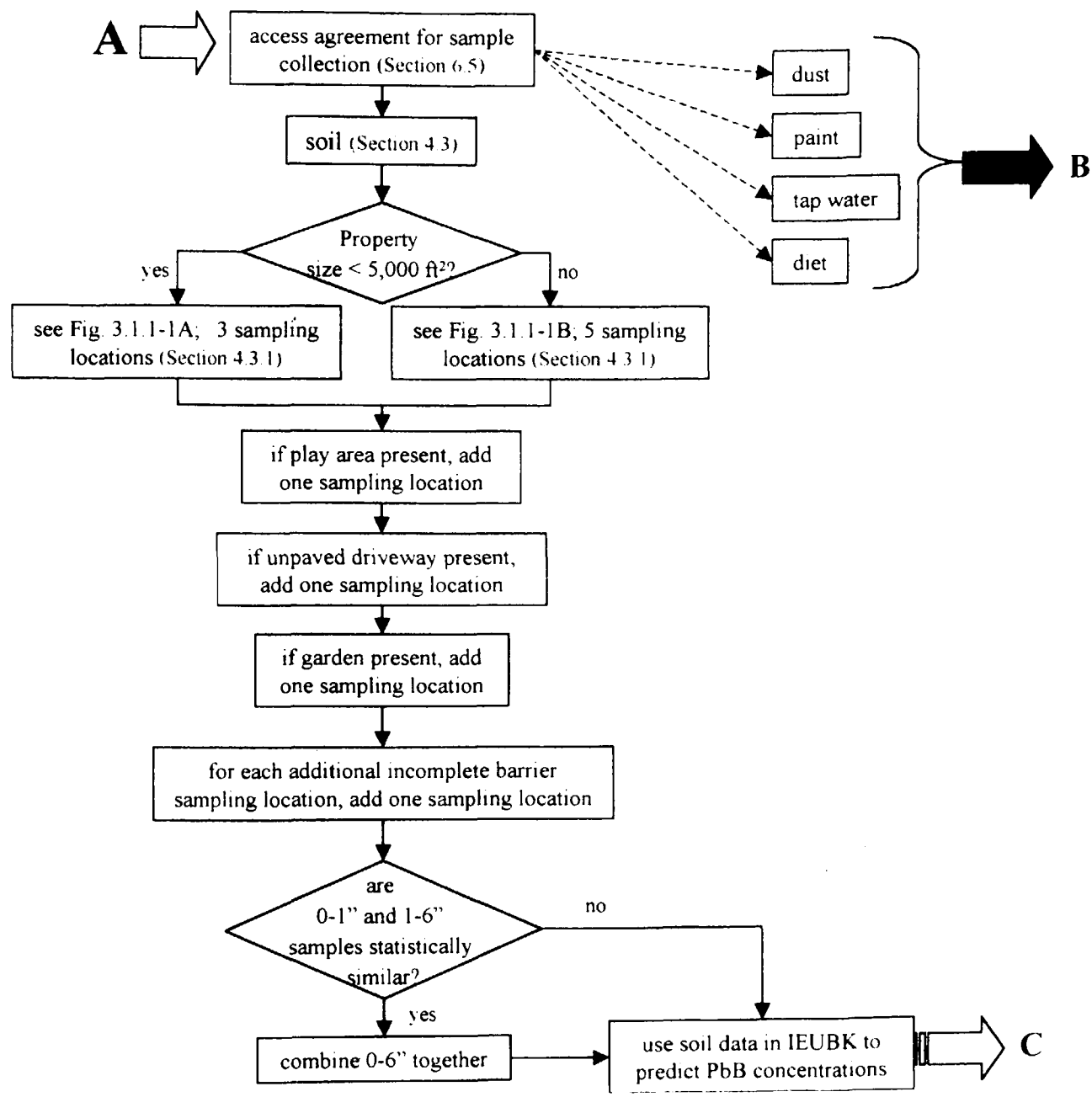


Figure 5-1. (continued)

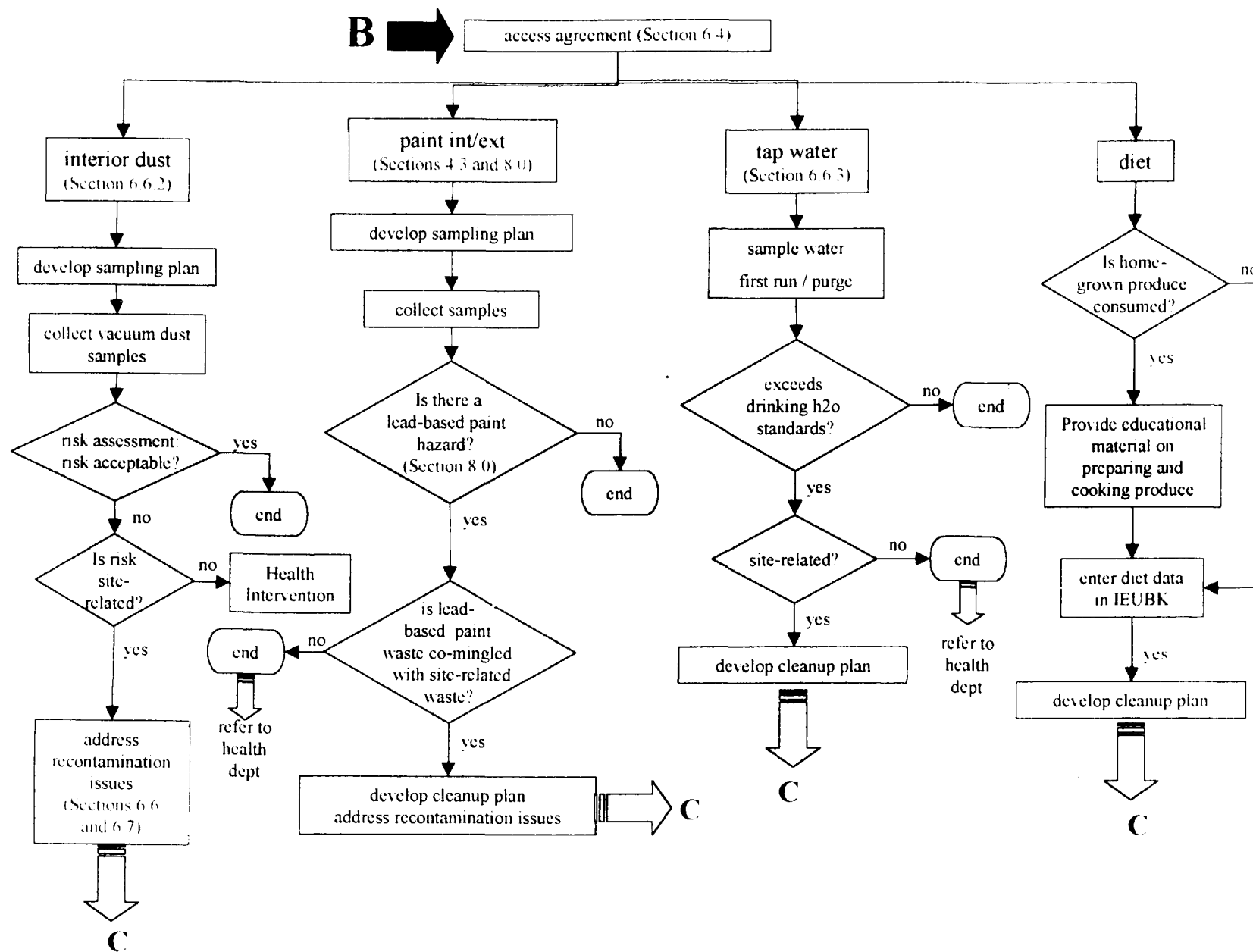
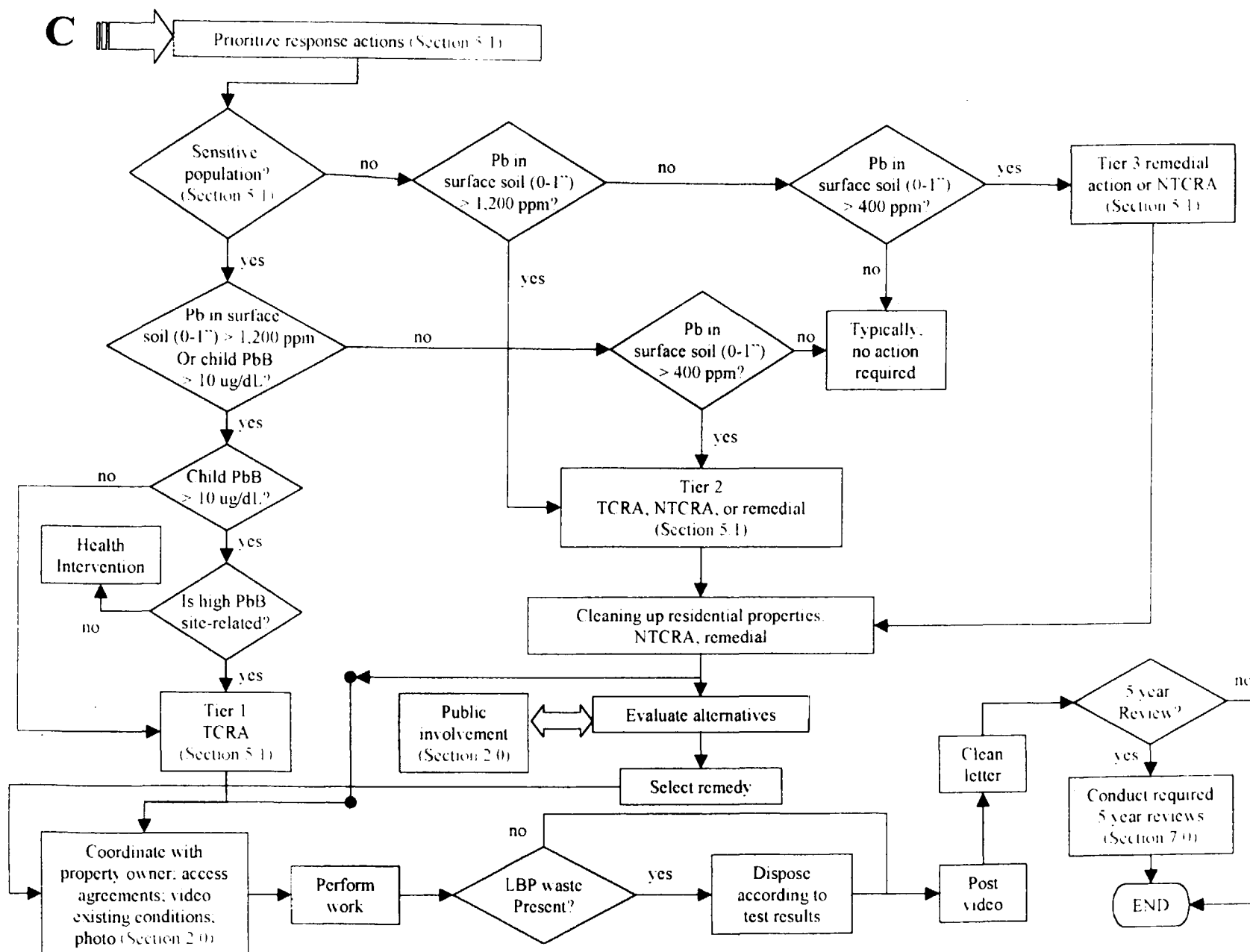


Figure 5-1. (continued)



The concentrations that are used to define tiers should not be confused with cleanup numbers, which are based on the PRG determined with the IEUBK model and an analysis that includes the nine criteria listed in the NCP (EPA, 1990b). The 1,200 ppm concentration is not an action level for TCRAs, but is intended to provide an alternative to running the IEUBK model if the project manager believes the site poses an urgent threat. Certainly, a TCRA could be justified above or below this concentration depending on the conditions at the site. The tiers are defined below (see also Figure 5-1).

- Tier 1 properties have both sensitive populations (children up to 7 years old or pregnant women) and soil concentrations in the surface soils (0–1" depth) at or above 1,200 ppm (EPA, 1997b, c). Also, Tier 1 sites can be identified based upon a demonstration of children's blood lead levels at or above 10  $\mu\text{g/dL}$ . Generally, TCRAs would be taken at Tier 1 properties.
- Tier 2 properties have either sensitive populations and soil lead concentrations in surface soils between 400 ppm and 1,200 ppm, or no sensitive populations but surface soil lead concentrations above 1,200 ppm, but not both. Tier 2 properties can be addressed through TCRAs or a non-time-critical removal actions (NTCRAs), or long-term remedial actions.
- Tier 3 properties have surface soil concentrations below 1,200 ppm, but above 400 ppm, and have no sensitive populations present. Tier 3 sites would typically be addressed through long-term remedial actions or NTCRAs.

Tier 1 should be the highest priority for immediate action and Tier 3 should be the lowest priority for immediate action. Residential properties can move into a different tier if conditions change (e.g., small children or pregnant women move into a house). A typical residential lead site will contain a combination of properties that fit into different tiers. The project manager must use judgement and funding limits to determine whether or not to perform a complete cleanup of contaminated residential properties (as defined in Section 1.3)

As discussed below, remedial actions for residential lead cleanups should use the IEUBK model. The IEUBK model should be used to assess risks posed by contaminated soils and to determine PRGs for soils at residential lead sites. In order to facilitate TCRAs, a demonstration of elevated blood-lead levels or elevated soil-lead levels at or above 1,200 ppm will usually be sufficient. If elevated blood-lead levels are the basis for concern, occupational contributions of lead, elevated lead levels in drinking water, lead from lead-based paint, and lead dust in the homes of children or adults with elevated blood lead should be examined first because these sources of lead can be significant (EPA, 1998b). At this stage, consultation with Regional risk assessors and public health officials (such as ATSDR) to better understand health impacts is encouraged.

## 5.2 LONG-TERM REMEDIAL ACTION

The 1994 OSWER Directive 9355.4-12 states OSWER's risk reduction goal for residential lead sites: "generally, OSWER will attempt to limit exposure to soil lead levels such that a typical (or hypothetical) child or group of similarly exposed children would have an estimated risk of no more than 5% of exceeding a blood lead of 10  $\mu\text{g/dL}$ " ( $P_{10} < 10\%$ ) (EPA, 1994b). It is important to note that this recommendation (i.e.,  $P_{10} < 10\%$ ) is meant to apply to a single residential property or another discrete exposure area, not on an area- or community-wide basis (i.e., 5 children out of every 100 actually exceed 10  $\mu\text{g/dL}$ ). It is also important to note that selecting a soil lead concentration in this manner will not guarantee that a given child will not exceed a blood lead level of 10  $\mu\text{g/dL}$ . Many factors other than soil concentration cause variance in blood lead levels: pica behavior, other sources of lead not included in the exposure unit, such as paint, diet, etc. (e.g., this could include soil at a camping site or other remote site frequented by the child).

The 1998 OSWER Directive 9200.4-27P ('Clarification') recommends that the IEUBK Model be used as the primary tool to generate risk-based soil cleanup levels at lead sites for current and future residential use (EPA, 1998b). Additionally, the 1998 Clarification states that response actions can be taken using IEUBK predictions alone, and that blood lead studies, while providing useful information, should not be used for establishing long-term remedial or non-time-critical removal cleanup levels at lead sites. Regarding exposure units at residential lead sites, the 1998 Clarification states: "... it is recommended that risk assessments conducted at lead-contaminated residential sites use the individual residence as the primary exposure unit of concern" (EPA, 1998b). This document clarifies the definition of exposure unit provided in the 1998 Clarification. In addition to the individual residence, accessible site-related lead sources outside the residential setting should also be evaluated to understand how these other potential exposures contribute to the overall risk to children. When the evaluation indicates a significant contribution to risk, cleanup measures should be determined for those areas.

Empirical blood lead data occasionally deviates significantly from IEUBK Model predictions. This can be due to numerous factors, including the implementation of lead exposure-reduction and health education programs, and uncertainties in the exposure parameters of the Model as well as uncertainties in the blood lead data (Mushak, 1998). Regarding this issue, the 1998 Clarification states: "Where actual blood-lead data varies significantly from IEUBK Model predictions, the model parameters should not automatically be changed. In such a case, the issue should be raised to the TRW to further identify the source of those differences" (EPA, 1998b). Basically, model inputs should be changed only when defensible, site-specific information that is specifically applicable to the parameters is collected. Moreover, these changes should also ensure that model outputs are protective of future residents. Examples of such information are dust lead concentration, drinking water concentration, bioavailability

data (e.g., *in vivo* pig studies), and soil-to-dust ratio. The predictive capacity of the IEUBK Model depends upon the representativeness of the inputs. Section 4 discusses the collection of the data required to estimate some of these inputs.

In summary, there is no national standard for lead in residential soil on a Superfund site; however, there is a consistent process by which residential soil lead cleanup levels are selected. The first step is to gather site-specific data as recommended in Section 4 of this handbook and review other guidance on the use of the IEUBK Model (EPA, 1994c; TRW web site: <http://www.epa.gov/superfund/programs/lead/ieubk.htm>). Risk assessors (and other data users) should be consulted early to assist with data collection and planning (EPA, 2000c). The next step is to get assistance from the regional risk assessor(s) to run the IEUBK Model with applicable site-specific inputs. Running the model will allow the determination of a site-specific PRG that corresponds to a  $P_{10}$  for a typical child, or group of similarly exposed children, that is no more than 5%. The last step is to select a site-specific residential soil lead cleanup level that is based on the model-derived soil lead PRG and an analysis of the nine criteria consistent with the NCP (Superfund sites only) (EPA, 1990b). If the proposed cleanup level is outside of the range of 400 ppm to 1,200 ppm lead, then the draft decision document for the site must be sent to the LSCG for review (EPA, 1997b).

**Lead Sites Consultation Group (LSCG)** – The Lead Sites Consultation Group (LSCG) was created in 1997 to promote national consistency in decision-making at lead sites across the country (EPA, 1997b). The main purpose of the group is to review key response decisions at lead sites. The LSCG is comprised of senior management representatives from the Waste Management Divisions in all 10 EPA regions along with senior representatives from the Office of Emergency and Remedial Response in EPA headquarters.

The LSCG is supported by EPA's Technical Review Workgroup for Lead (TRW) and the national Lead Sites Workgroup (LSW). There are three triggers that cause the review of lead-related proposed plans by the LSCG (EPA, 1997b):

- 1) Residential contaminated lead sites with cleanup levels outside a 400 to 1,200 ppm soil-lead level;
- 2) Sites that envision actions to address non-soils lead contaminated media;
- 3) Routine LSW deliberations that identify a unique or precedent setting site issue(s).

## **6.0 APPLICATION OF CLEANUP NUMBERS/REMEDIATION**

The following section provides a detailed discussion of recommended methods to remediate residential soil and other sources of lead in residential settings. The guidelines stated below apply to early/interim actions and long-term remedial actions. However, due to funding limitations that apply to time-critical removal actions, site-specific determinations regarding yard size limitations, and whether to clean up empty lots and other sources of lead (paint, dust, tap water) should be made by the project manager on a site-by-site basis. This document describes the minimum requirements for remediating lead-contaminated sites. Per the Superfund process, state ARARs must be addressed in the remedial design.

### **6.1 MINIMUM EXCAVATION DEPTH/SOIL COVER THICKNESS**

A minimum of twelve (12) inches of clean soil is needed to establish an adequate barrier to contaminated soil in a residential yard for the protection of human health. Cover soil can either be backfill placed after excavation or placed on top of the contaminated yard soil. The rationale for establishing a minimum cover thickness of 12 inches is that the top 12 inches of soil in a residential yard can be considered to be available for direct human contact. With the exception of gardening, the typical activities of children and adults in residential properties do not extend below a 12-inch depth. Thus, placement of a barrier of at least 12 inches of clean soil will generally prevent direct human contact and exposure to contaminated soil left at depth.

Removal of lead-contaminated soil to depths greater than 12 inches should be considered at sites in cold regions with non-soil lead contamination sources, such as tailings and crushed battery casings, and whenever it is cost-effective. The additional response cost should be balanced against the future ICP and monitoring costs of leaving the material in place at depth. Full vertical removal of residential soil has many advantages, such as reducing or avoiding the costs of the operation and maintenance of the soil cover, the placement of subsurface barriers/markers, and obtaining environmental easements. Full removal of contaminated soil satisfies EPA's preference for permanent remedies and normally allows the remediated yard to return to unrestricted use.

Twenty-four (24) inches of clean soil cover is generally considered to be adequate for gardening areas, however, site specific conditions that may require more soil cover (e.g., presence of burrowing animals) should be considered. A 24-inch barrier is necessary to prevent contact of contaminated soil at depth with plant roots, root vegetables, and clean soil that is mixed via deep rototilling. Raised garden beds may be built to obtain 24 inches of clean soil, and may be more cost effective than excavating to

24 inches in depth; i.e., excavate 12 inches of contaminated soil, then add 24 inches of soil to create a 12" raised bed.

## 6.2 SOIL CLEANUP OPTIONS

Currently, there are only two remedial actions that are considered to be protective, long-term (not interim) remedial actions at residential properties: (1) excavation of contaminated soil followed by the placement of a soil cover barrier and (2) placement of a soil cover barrier without any excavation of contaminated soils. Excavation followed by the placement of a soil cover is the preferred method and is strongly recommended at sites with relatively shallow contamination, such as many smelter sites. Excavation and placement of a soil cover should be performed whenever the specific conditions of a site do not preclude it. For example, it may not be feasible to fully excavate a very large site because of prohibitively high costs. The advantage of the preferred method is that it is a permanent remedy in terms of removal of lead from areas where children may be exposed.

During remediation of very large residential properties, or large public park areas where contamination will be left at depth, placement of a soil cover without excavation of contaminated soil can provide significant cost savings to the project. However, strong consideration should be given to the flooding potential of the site, the potential for erosion, and whether the site has adequate drainage before deciding on placement of a soil cover without excavation of contaminated soils. Generally, excavation and backfill of the areas adjacent to the house, transitioning to no excavation in areas at some distance from the house will promote drainage and provide the most economical solution for large properties.

Several treatment technologies are currently under development to reduce the bioavailability of soil lead, but are not yet proved to be protective in the long-term. These include amending the soil with phosphorus or high iron biosolids composts. Preliminary results have shown phosphate treatment to reduce the bioavailability of lead in soil by as much as 50 percent. This would mean that soil with lead concentrations in the range between cleanup levels calculated with the pre- and posttreatment bioavailability values could be treated instead of removed (e.g., if the IEUBK model-derived cleanup number using the pre-treatment bioavailability were 400 ppm lead, and the calculated post-treatment cleanup level were 800 ppm lead, then the yards with lead concentrations between 400 ppm and 800 ppm could be treated rather than excavated or capped).

Over time, the efficacy of the phosphorous treatments appears to increase. This is consistent with what is predicted using thermodynamics. However, to date, the treatability studies have been monitored for 3-5 years. Additional monitoring will be necessary to assure the long-term stability of the observed reduction in bioavailability.

Some other existing technologies for soil remediation that are not currently considered acceptable for residential lead cleanups are rototilling, phytoremediation, and interim controls, such as mulching, seeding, and sodding (without prior removal of contaminated soil). Rototilling is not considered a permanent, protective remedy in that no lead removal occurs, and adequate mixing of soil is difficult, if not impossible, to achieve; additionally, rototilling may increase the volume of soil, which ultimately requires remediation. Mulch, sod, or other vegetative covers are generally not considered permanent, protective remedies in that no lead removal occurs, and there is no guarantee that grass, mulch, or other vegetative cover will be maintained in good condition over time.

Additionally, land use changes that may occur within a yard, such as starting a garden or putting in a swing set, are not precluded in any way by mulch, sod, or other vegetative cover. Lastly, phytoremediation is not currently an appropriate technology for residential lead cleanups due to several factors: (1) the lead concentrations at many residential sites are not within the optimal performance range for the plants; (2) the plants may concentrate lower level lead contamination and present an increased disposal cost if the plants fail the TCLP test, but the unremediated yard soil does not fail; (3) the length of time (sometimes greater than one year) required for remediation; (4) the aesthetics of tall plants growing in a residential yard for a long period of time as well as the potential conflicts with local regulations pertaining to yard maintenance; and (5) the depth of remediation achieved may be inadequate.

### **6.3 INTERPRETING SAMPLING RESULTS**

After sampling a residential yard as described in Section 4, excavation and/or soil cover placement should be performed as described below (Figure 6-1). In all cases, the goal is to remove all contaminated soil or provide a 12" barrier. For excavation of contaminated soil and replacement with a clean soil cover (and placement of a visible barrier if applicable):

- If the 0–1" horizon exceeds the cleanup level, a 6 or 12" barrier is required, depending on the 6–12" sample horizon results;
- If the 1–6" or 0–6" horizon exceeds the cleanup level, a 6 or 12" barrier is required, depending on the 6–12" sample horizon results;
- If the 6–12" horizon exceeds the cleanup level, a 12" barrier is required. A visual barrier is required if the 12–18" horizon exceeds the cleanup level;
- If the 6–12" horizon does not exceed the cleanup level, a 6" barrier is required; a visual barrier is not required.

Depth	Does the Soil Concentration Exceed Action Level?							
0-1"	Yes	Yes	Yes	Yes	No	No	No	No
1-6"	Yes	Yes	No	No	No	Yes	No	Yes
6-12"	Yes	No	Yes	No	No	No	Yes	Yes
Depth of excavation	12"	6"	12"	6"	No action	6"	12"	12"
Required soil cover thickness	12"	12"	12"	12"	No action	12"	6"	12"

**Figure 6-1. Interpreting Sampling Results.** The figure suggests remedial actions based on the results of composite soil samples collected for each of the depth intervals shown. Find the column of the table that agrees with the soil sample results for your site, then read down the table to determine the depth of soil to remove and the thickness of the soil cover required. For example, the heavy border around the third column of the table corresponds to a situation where the average lead concentration in the 0-1" and 1-6" depth intervals exceed the action level, but the 6-12" interval does not. In this example, it is recommended to remove the top 6" of contaminated soil and then to place a 12" soil cover. In all cases, the goal is to provide a minimum 12" barrier of clean soil. Please refer to Section 6.3 for further explanation.

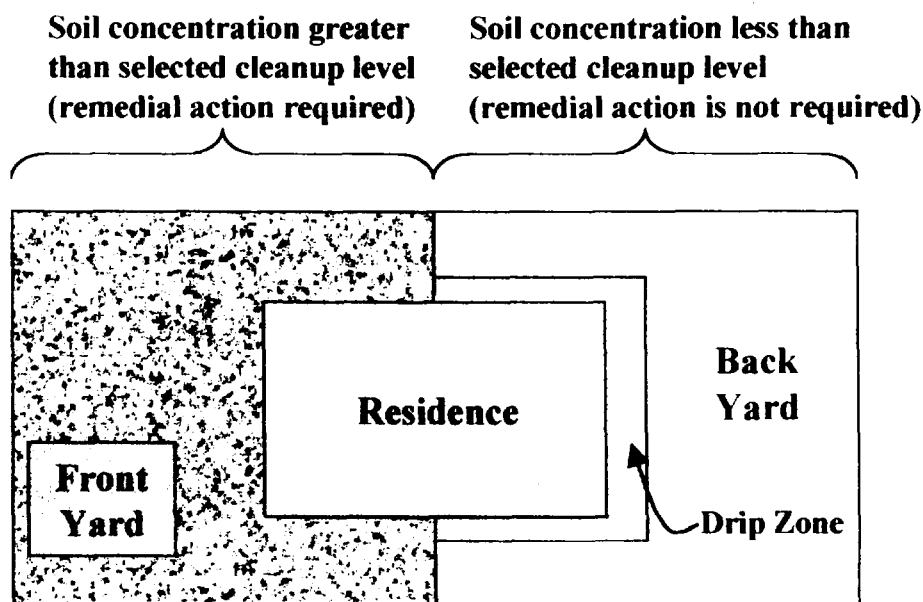
For placement of a clean soil cover without excavation (and placement of a visual barrier if applicable):

- If the 0–1" horizon exceeds the cleanup level, a 12" soil cover and visual barrier are required;
- If the 0–6" or 1–6" horizon exceeds the cleanup level, a 12" soil cover and visual barrier are required;
- If the 6–12" horizon exceeds the cleanup level (but not the 0–1", 1–6", or 0–6" intervals), a 6" soil cover is required;
- If only the 12–18" horizon exceeds the cleanup level, no action is required.

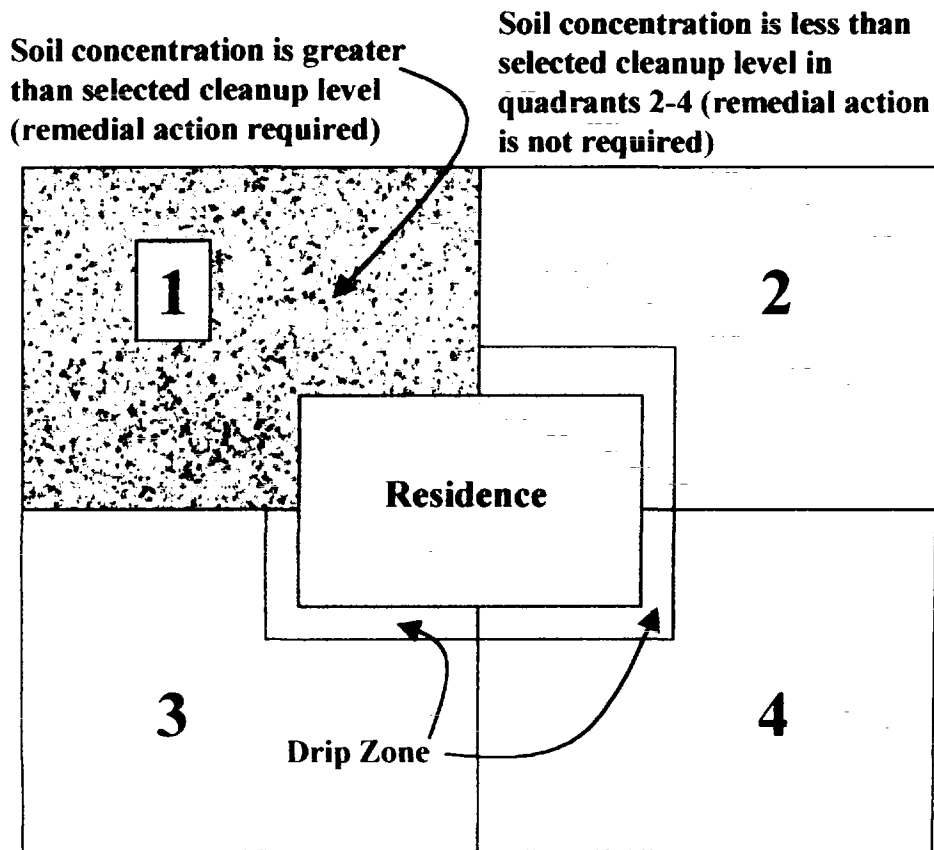
The decision to perform soil cleanup to depths greater than 12 inches should be considered on a site-by-site basis. Some advantages to full vertical soil cleanup are listed in Section 6.1. However, there are many sites where lead contamination is located at depth. Full vertical soil cleanup may not be cost-effective and/or feasible at such sites. The depth of excavation and soil cover thickness is an important factor to be considered during the analysis of the nine criteria per the NCP (for Superfund sites) (EPA, 1990b). Potential for freeze/thaw upward migration, groundwater contamination, and the cost, extent, and effectiveness of ICPs are some of the factors to be considered in this analysis.

Sampling results obtained for residential lots may indicate that only a portion of the lot contains soil that exceeds the selected cleanup level. For properties less than 5,000 square feet, the spatial scale for the remedial decision should be one-half of the yard. For properties greater than 5,000 square feet, the property should be divided into four quadrants and a remedial decision should be made for each quadrant. It is usually acceptable to excavate only the portion(s) of the lot that exceed the cleanup level (Figures 6-2a and 6-2b). However, removal of the sod layer and resodding/reseeding the unexcavated portion(s) of the lot is strongly recommended to promote consistency in the vegetative cover of the yard. When interpreting sampling results for a property, the sampling results of surrounding properties should also be considered to lessen the probability of mislabeling the site as being below the cleanup level when it is actually above and to avoid "patchwork cleanup" patterns, which are prone to recontamination.

If the only portion of the yard that exceeds the selected cleanup level is the drip zone, the exterior paint should be checked for lead content. If the drip zone contamination does not appear to be paint-related, the drip zone should generally be cleaned up. This will depend on the quantity, location, and condition of lead-based paint relative to the drip zone samples. If the drip zone contamination appears to be solely paint-related, EPA should promote the remediation of the exterior lead-based paint by local health agencies, other local government agencies, state health agencies, and/or the homeowner. At a minimum, the resident should be notified and informed of the disclosure requirements (Section 1.2). Consideration should be given to also notifying the relevant local government agencies and informing them about available remedies, such as HUD grants.



**Figure 6-2a.** Partial cleanup of residential lot less than or equal to 5,000 square feet in size. In this example, the lead concentration measured in the front yard exceeds the selected cleanup level while the concentration measured in the backyard does not. Cleanup may be limited to the front yard although it is recommended that the sod layer in the entire lot be removed to promote consistency in the vegetative cover on the property. The entire drip zone should be cleaned up if the average lead concentration exceeds the cleanup level. For example, in the above figure, the drip zone in the back yard (as well as the front yard) should be cleaned up if the average concentration in the drip zone exceeds the cleanup level. Please refer to Section 6.3 for further explanation.



**Figure 6-2b. Partial cleanup of residential lot greater than 5,000 square feet in size.** In this example, the lead concentration measured in quadrant 1 exceeds the selected cleanup level while the concentration measured in quadrants 2-4 do not. Cleanup may be limited to the quadrant 1 although it is recommended that the sod layer in the entire lot be removed to promote consistency in the vegetative cover on the property. The entire drip zone should be cleaned up if the average lead concentration exceeds the cleanup level. For example, in the above figure, the drip zone in quadrants 2-4 (as well as quadrant 1) should be cleaned up if the average concentration in the drip zone exceeds the cleanup level. Please refer to Section 6.3 for further explanation.

## 6.4 CLEANUP LIMITATIONS

Regardless of the size of the property, the area remediated on a single property should not exceed one acre. This limitation is based on three factors: 1) typical lot sizes in residential areas throughout the country generally do not exceed one acre; 2) the portion of a property where the majority of exposure to contaminated soil occurs generally does not exceed one acre; and, 3) EPA should not excavate/cover with soil the entirety of very large yards due to cost considerations.

The goal for cleanup of a yard that exceeds one acre is to excavate or cap the portion of the yard that is in frequent use and continue to limit exposure in the unremediated portion of the yard. To this end, it is recommended that the unremediated portion of such a yard be fenced to clearly delineate the remediated and unremediated areas and to limit the potential for off-site migration of contaminants (e.g., vehicle tracking). Exceptions to this may include areas outside the one-acre area that are used for recreation and gardening, areas with the potential for residential development, and areas in close proximity to other residential areas. As stated in Section 6.5, any unremediated areas of a property should be documented on the cleanup documentation letter for such property, and consideration should be given to including those areas in the site ICP.

If contaminated soil is not removed to the full depth of contamination (i.e., where soil concentration > cleanup level) on a property, a permanent barrier/marker should be placed to separate the clean fill from the contamination. This applies to both incomplete vertical excavation with placement of a soil cover and placement of a soil cover without excavating contaminated soil. The barrier should be easily visible and not prone to frost heave. Selection of an appropriate permanent barrier/marker should be based on the type of contamination left in place, the chemical/physical characteristics of the soil (e.g., pH), the potential for upward migration of the contamination, and/or the types of institutional controls developed for the site. Examples of suitable barriers/markers include snow fencing (usually orange), a clean, crushed limestone layer, and geofabric.

Empty lots that are zoned residential and contain soils with lead concentrations greater than the cleanup level should be cleaned up when in close proximity to other residential lots. Examples of this are lots between two houses and lots that are near occupied lots. A site-specific determination will be required for these situations. Also, lots used for vehicle parking should be sampled, and cleaned up if necessary, or access restrictions put in place to prevent recontamination (e.g., vehicle tracking of contaminants) even if no current direct exposure exists. However, it is not the intent of EPA to clean up tracts of remote, undeveloped, lead-contaminated land that may be developed into residential lots in the future. This cleanup responsibility should be borne by the land developer. Institutional controls should be developed

to ensure safe development in these areas, and developers should be held responsible for improper cleanup of the areas during residential construction.

Another practical limitation to the extent of cleanup may arise at sites with high background lead concentrations. Many of the "Lead Sites" on the National Priorities List are located in areas with high background lead concentration. Often this problem is exacerbated by the presence of high background concentrations of lead in various media (such as soil and groundwater) from anthropogenic sources such as automobile emissions, mining, and smelting. In some cases, natural and/or anthropogenic background concentrations may present a significant risk. Cleanup will not eliminate this risk. In these cases, cleanup should be limited to areas impacted by site-related contamination. Significant risks from natural and anthropogenic background concentrations of soil lead may be addressed separately (EPA, 1989). Public education about ubiquitous risks should be incorporated early in the process to help the community understand that Superfund actions are not designed towards general risks, but rather those from specific releases to the environment.

Setting cleanup levels at background concentrations may not be protective of human health and the environment. In situations like these, it may be appropriate to examine land uses that limit exposures through implementation of institutional controls. Alternatively, it may be appropriate to develop a final remedy around an area-wide response strategy with appropriate parties to address area-wide contamination to the extent practicable. This risk management strategy has been successfully employed at many area-wide sites across the country. For more information on this approach, please refer to the 1998 Clarification (EPA, 1998b). This approach will help prevent the frequent occurrence of an impractical "clean oasis" in area-wide lead sites. The site-specific factors will dictate what range of alternatives and what cleanup levels are necessary to achieve a protective remedy satisfying the nine criteria specified in the NCP.

In order to determine the significance of background concentrations at area-wide lead sites we need to distinguish background related risks from non-background related risks for the purpose of:

- determining if an area-wide response strategy is appropriate;
- determining if achieving certain ARARs, risk reduction objectives, or other cleanup objectives will be technically impracticable due to the risks posed by off-site sources; and
- understanding the total risks to human health and the environment.

Remedial decisions at area-wide lead sites often involve a comprehensive response coordinated with other responsible authorities, such as a local public health district, state departments of environmental protection, housing agencies, and private parties. Additional guidance is available for developing a risk management-based response strategy that is protective of human health and the environment (EPA, 1988).

## 6.5 YARD CLEANUP SPECIFICS

It is important to define the limits of the properties that will be remediated. The use of property lines rather than temporary features, such as fence lines, to delineate boundaries is recommended. The use of temporary features may result in partial cleanup of some properties.

Whether remediation consists of excavation and placement of soil cover or just the placement of a soil cover, consultation with the property owners is essential to the development and implementation of response actions and may necessitate property-specific deviations to the guidelines listed in this section. Flexibility is essential to a successful residential lead cleanup program. Some residents may want to pay for upgrades during the cleanup of their yard, such as paving a driveway after excavation, or to have some yard features removed, such as taking out a damaged patio. Within reasonable limits, such requests should be entertained on a yard-by-yard basis. Granting such requests can greatly contribute to building public trust and satisfaction with the cleanup program.

Prior to cleanup of a residential yard, access from the property owner must be obtained; access obtained from tenants or renters is not sufficient. Several examples of access agreements are presented in Appendix C. If possible, access for remediation should be obtained at the same time access for sampling is being sought. Examples of combined sampling/remediation access agreements are included on pages C-4 and C-5 of Appendix C. Combining sampling and cleanup access will avoid potentially lengthy delays. Additionally, access should be obtained for any interior dust sampling and/or cleaning that will be performed at the residence (Section 6.6.1). Sample access agreements for dust cleanup are presented in Appendix D. Many residents may refuse access for dust cleanup while granting access for yard-soil cleanup. Combining dust access agreements with other access agreements is not recommended.

Prior to initiating cleanup activity, the condition of each property should be documented and recorded on videotape. 'Cleanup activity' includes any disturbance of the property, including the removal of debris and dilapidated structures that may be required prior to initiating the excavation of contaminated soil. An example of a property inspection form is provided in Appendix E. EPA should enter into a written agreement with the resident regarding any special requests or considerations in cleaning up the yard, e.g., replacing concrete walkway with brick. All costs associated with special requests and considerations must be borne by the homeowner. Any contaminated yard areas that will not be cleaned up, special resident concerns, and any deviations from strict soil excavation or capping should be noted on this agreement.

Other possibilities for cleanup-related agreements include sod/lawn watering agreements. A sod-watering agreement basically allows for payment of residents for watering the sod that is placed by the remediation contractor. A payment is made before watering is required to cover the water bill and some

of the time involved. A second payment is made if, at the end of one month, the sod is in good condition. A similar agreement should be established for maintaining lawns that have been initiated by hydroseeding. This can be a useful incentive program that can also save money. The contract with the remediation contractor should require the contractor to establish vegetation on each property, restore the pre-construction drainage patterns on each property, and perform repairs for damages to the property.

Relocation of residents during yard soil remediation is rarely needed and is generally not recommended (EPA, 1999b). (Guidance is available online at: <http://www.epa.gov/oerrpage/superfund/tools/topics/relocation/index.htm>.) Specific safety issues during residential yard cleanup, including ingress and egress to the home, should be coordinated with the property owner/residents and spelled out in the Health and Safety Plan.

Incomplete barriers (such as rock or gravel) or minimal use areas (such as areas under porches), which exceed the applicable cleanup level, should be cleaned up to the extent practical. Although removal is preferred, if it is not feasible to clean up the area, a barrier, which effectively limits access, should be constructed. For example, for areas underneath porches, typically the preferred barrier would be shotcrete (sprayed concrete that can easily be placed in tight or confined areas). It may be preferable to place asphalt rather than gravel on heavily-trafficked roads or driveways, especially those that experience severe erosion.

In all cases, every attempt should be made to clean up the entire yard (subject to cost limitations discussed below), however, any residential yard areas without permanent barriers that the resident requests to leave unremediated, such as gardens or patios, should be sampled separately to determine if the selected cleanup level is exceeded. If the cleanup level is exceeded and the owner refuses to allow cleanup of that portion of the yard, then the cleanup documentation letter issued to the owner should note the unremediated area.

## 6.6 CLEANUP OF OTHER SOURCES OF LEAD

Lead in the environment can originate from many sources. In addition to soil, the main sources to consider when performing cleanup activities are interior and exterior lead-based paint, lead-contaminated interior dust, drinking water, and occupational exposure resulting in subsequent contamination of homes. Generally, sources other than soil, paint, dust, and tap water cannot be remediated by EPA in the course of residential lead cleanups.

Ultimately, the project managers should strive to address any unacceptable lead-exposure risks at the residence. Sampling and the establishment of cleanup mechanisms needed to take action, such as HUD

grants for paint abatement, should be performed as early in the remedial process as possible. Even so, it may not be possible to address all sources of lead in the ideal sequence. When this occurs, other measures should be taken to minimize the potential for recontamination (i.e., to protect the remedy). For example, if deteriorating exterior lead-based paint is present, it is recommended that it be removed prior to initiating any soil cleanup activities in the yard.

Due to transport of lead among media, the preferred sequence of lead cleanup activities at a residence with lead-based paint and lead-contaminated soil would be to clean up the paint first, then the yard soil, and then the interior dust. Cleanup activities performed counter to this sequence increase the risk of recontamination. For example, performing a soil cleanup first at a residence with exterior paint problems increases the potential for recontamination of the soil from the exterior paint. Similarly, interior dust can be recontaminated by interior lead-based paint. Exterior sources have been shown to cause recontamination of the interior when cleaned before community-wide yard cleanup is completed (EPA, 2000d). Accordingly, project managers should make every effort to coordinate the sequence of cleanup activities to prevent recontamination.

The National Contingency Plan limits the use of Superfund dollars to address interior lead-based paint (see Section 1.2) (EPA, 1990b). If a mechanism exists for addressing the paint, such as a HUD grant or a Supplemental Environmental Project (SEP), then the timing of the paint encapsulation or abatement activities may not coincide with the soil cleanup. Additionally, residents may be more reluctant to grant access for dust remediation since it is more intrusive. On the other hand, actions taken to address lead in drinking water usually can be taken independently from any soil, dust, or paint cleanups, and should be done as soon as practical.

Supplemental Environment Project (SEP) – Environmentally beneficial projects which a defendant/respondent agree to undertake in settlement of an enforcement action, but which the defendant/respondent is not otherwise legally required to perform.

### **6.6.1 Lead-Based Paint**

The 1998 Clarification presents OSWER's policy with respect to remediation of interior paint, exterior paint, interior dust, and lead plumbing. Regarding interior lead-based paint, the 1998 Clarification states:

"EPA has limited legal authority to use Superfund to address exposure from interior lead-based paint. As a policy matter, OSWER recommends that such exposures not be addressed through actual abatement activities. However, EPA Regions should promote addressing interior paint risks through actions by others, such as HUD, local governments and health authorities, or individual homeowners as a component of an overall site management strategy. Any activities to

clean up interior lead-based paint by potentially responsible parties (PRPs) or other parties should not result in an increase of the risk-based soil cleanup levels" (EPA, 1998b).

Regarding exterior lead-based paint, the 1998 Clarification indicates that the Regions should avoid using the Superfund trust money for removing exterior lead-based paint and soil contaminated from lead-based paint. However, Superfund dollars may be used to respond to exterior lead-based paint to prevent recontamination of soils that have been remediated, but only after determining that other funding sources are not available. The 1998 Clarification states: "As with interior lead-based paint abatement, EPA Regions should promote remediation of exterior lead-based paint by others, such as PRPs, local governments, or individual homeowners. Cleanup activities of exterior paint conducted by PRPs or other parties should not result in an increase of the risk-based soil cleanup levels" (EPA, 1998b).

As a practical matter, project managers should inform each resident regarding the presence or absence of lead-based paint in their home, and options for encapsulation and abatement. The local health agency and/or the state health agency should be informed regarding the availability of HUD grants for paint assessment and abatement. Additionally, regarding PRP-funded cleanups, if any penalties are being considered for noncompliance (Section 6.9), consideration should be given to allowing the PRPs to perform a SEP for paint assessment and abatement in lieu of some or all of the penalty amount.

### **6.6.2 Interior Dust**

Lead-contaminated interior dust can be derived from multiple sources, including exterior soil, interior and exterior paint, home owner hobbies, workplace, and other exterior sources; thus, it may be difficult to differentiate between sources of dust contamination. Household lead dust contamination may be a significant contributor to elevated blood-lead levels, especially for younger children (under the age of three), and may need to be evaluated in determining risks and cleanup actions at residential lead sites. However, as pointed out previously, there are limitations on EPA's authority to abate these sources of contamination as responses are aimed at addressing releases or threatened releases to the environment (EPA, 1998b).

Based on the 1998 Clarification, OSWER recommends that Superfund monies should generally not be used to take actions for addressing residential dust exposures due solely to interior paint or other interior sources. However, Superfund monies can be used to address interior dust if it can be shown to be derived from an exterior pollution source (e.g., air lead concentration caused by lead smelter, mining or mineral processing). Dust mat sampling, which was done at the Bunker Hill Site in Idaho (EPA, 2000d), is one possible method of lead source identification; speciation, which is costly, is another method. (Dust mats are used to measure dust lead concentration and loading rates in residences and other structures.) The

recommendations presented here generally apply to sites where interior dust is attributable to exterior sources, but could also be used as a guide for addressing other interior dust sources.

If the lead in interior dust is solely derived from interior paint, EPA should promote addressing interior dust risks through the actions of others, such as HUD, State and local governments, PRPs, or individual homeowners, as a component of an overall site management strategy. The overall site strategy, as outlined below, should also consider the proper phasing/sequencing of actions to address the multiple sources of lead risks at residential lead sites, as discussed at the beginning of Section 6.6.

The baseline risk assessment should document the relative contributions of lead uptake from all relevant media including direct soil exposures and secondary exposures to soil in indoor dust. Replacement of defaults with a site-specific value for the interior dust concentration, or the soil-to-dust relationship ( $M_{sd}$ ), should be justified through the use of high quality, compelling, site-specific data (EPA, 1994c, 1998d). Dust sampling is preferred for risk assessment and remedial decisions, but dust modeling may be needed to develop or refine soil action levels.

Lead-contaminated interior residential dust presents a significant exposure pathway that can readily be addressed. Consequently, significant health benefit is gained by removal of contaminated interior dust as early in cleanup activities as possible. However, exterior contamination sources present a threat of recontamination to interior of residences (EPA, 2000d; TerraGraphics, 2001). Therefore, any interior dust cleanup actions should be periodic throughout the project and should culminate in a final cleaning of all residences exceeding an action level after the exterior sources have been remediated. As a practical matter, risk management and reduction may need a phased strategy as recommended below:

- |                             |   |
|-----------------------------|---|
| <b>Early-Phase Actions:</b> | Public awareness and health education efforts should be initiated immediately. Entry way dust mats should be provided to residents. HEPA-filter vacuum cleaners should be provided for use by residents. If warranted, a program to abate interior lead-contaminated dust in homes with acute levels should be initiated to provide temporary risk reduction. Establish appropriate public health partnerships with state and local health departments, ATSDR, and HUD as early as practical. |
| <b>Mid-Phase Actions:</b>   | The source of the interior dust lead contamination should be identified. Monitoring of the changes in lead-contaminated dust (e.g., lead loading in dust, lead concentration in dust, exterior-to-interior lead transport) should be initiated. The public awareness health education efforts and availability of HEPA-filter vacuum cleaners for use by residents should be continued.   |

Assistance to remove and dispose of old carpets should be provided to residents after yard cleanup has occurred.

**Final-Phase Actions:**

Once the exterior lead sources that were found to contribute to interior dust have been addressed, the final step should consider the active remediation of interior lead-contaminated dust. Actions may include: removal of carpeting, cleaning heat and ventilation ducts, wet wiping hard surfaces and soft surfaces (furniture, draperies, bedding, clothing, etc.). Most of these actions should be limited to living spaces. Areas such as attics, crawl spaces and other non-living spaces need not be addressed unless they are shown to be a continued source of contamination to the living areas. It is important for dust remediation to be performed as the last phase in the site cleanup process to minimize the risk of recontamination.

### **6.6.3 Lead Plumbing/Tap Water**

The 1998 Clarification states: "Generally CERCLA does not provide legal authority to respond to risks posed by lead plumbing within residential dwellings. It should be noted that the water utility is responsible for providing clean water to the residences. As with interior dust, OSWER recommends that EPA Regions coordinate with local agencies to establish a health education program to inform residents of the hazards associated with lead plumbing and how to protect themselves by regularly flushing, or preferably, replacing lead pipes. Soil cleanup levels should not be adjusted to account for possible remediation of lead plumbing" (EPA, 1998b).

The 1998 Clarification discusses lead plumbing only. With regard to tap water, it should be sampled, and lead levels in the purged sample in excess of the Maximum Contaminant Level (MCL) established by the Safe Drinking Water Act should be addressed. In general, lead concentrations in the purged sample greater than a removal action level (RAL) of 30 µg/L should be addressed through TCRA's; concentrations between the MCL and RAL should be addressed through NTCRA's or long-term remedial actions. Actions that could be taken include provision of bottled water, connection to a municipal water supply, tap filtration, and installation of deep wells (in remote areas and where groundwater is contaminated). Regarding first run exceedance for lead, the homeowners should be notified that they may need to address a plumbing or corrosion problem, which is outside of the scope of Superfund.

## 6.7 PREVENTION OF RECONTAMINATION

Project managers should take steps to mitigate recontamination. During site closeout and for five-year reviews for large area sites, the project manager should also check for recontamination at levels which may threaten the remedy.

At many large-area lead sites, cleanup occurs over a long period of time and through multiple phases, throughout which the potential of recontamination exists. During each of these phases, windblown dust sources, vehicle tracking, flooding, and other mechanisms recontaminate previously cleaned areas. Although best management practices should minimize the movement of contaminated material from each residence being cleaned, vehicle tracking of contamination from areas yet to be cleaned up can significantly raise concentrations of contaminants in cleaned areas. During the early phase, typically an emergency response action, cleanup is focused towards Tier 1 properties, and cleanup favors a "hop scotch" approach to address the worst risks first. This method of remediation can result in recontamination of clean properties. Confirmation samples should be collected in any areas that have been potentially recontaminated.

Another aspect of large-area lead sites is that complete cleanup beneath residential properties does not always take place for a variety of reasons; instead a barrier or soil cover is put in place over contaminated soils. Flooding can pose a serious problem for these areas in that flood waters can erode away clean materials leaving subsurface contamination exposed, and entrained sediments bearing contamination may be left on top of newly remediated properties. Inadequate drainage of typical runoff can move lead into cleaned areas (e.g., lead particles on a crowned road with no curb and gutter may be rinsed onto adjacent residential properties with normal rainfall). Additionally, the activities of burrowing animals can bring contaminated soils to the surface.

Best Management Practice (BMP) – In general, BMPs are a combination of practices that are determined to be the most effective and practicable means of controlling point and nonpoint pollutants at levels compatible with environmental quality goals. In this document, BMPs specifically refer to measures taken during construction activities on properties where contamination has been left at depth to prevent the transfer of those contaminants to other media.

Recontamination of clean soil cover can be problematic due to ongoing homeowner projects, such as digging a hole through a clean barrier to install fence posts or a new tree or shrub, if preventative measures are not taken. In addition, large scale residential development projects that may raze old housing in favor of new will frequently recontaminate areas where lead-contaminated soil was left at depth, without appropriate Best Management Practices (BMPs) in place. EPA

provides guidance on the implementation of BMPs in construction activities at sites where contamination is present (EPA, 1997d) .

Windblown dust can pose a significant threat both to health of individuals at a site and can cause recontamination. A prime example of windblown dust can be seen at a tailings impoundment that has dried and is no longer water covered. Most tailings impoundments are large; a wind sweeping across the face of one can carry substantial amounts of contaminated dust and then deposit these particles on a downwind residential area, both causing increased exposure to contaminants, and recontaminating clean areas. Wind blown dust sources are typically a key issue to be addressed early in the sequencing of site activities to minimize this migration.

These are but a few examples of how recontamination can be an ongoing, if subtle, problem that needs to be considered at every site during each phase of cleanup. Although mechanisms vary from site to site, the types of response actions put in place and the sequence in which these actions take place can play a significant role in enhancing the permanence of a remedy.

### **6.7.1 Early Actions**

Early response actions (including cleanups for sensitive subpopulations) can be an essential aspect of early action at a site, as discussed above. These actions should be conducted simultaneously with source area control. The following are considerations that may reduce the potential for recontamination when scoping an early action.

- Seek permanence in selecting the cleanup alternative(s), if possible, such as complete removal to depth of soil contamination at properties where there is an acute risk.
- Consider cleanup of adjacent properties simultaneously that may threaten the permanence of the early action.
- Control fugitive dust sources, access, tracking, and erosion of contaminants to the extent possible.
- Perform HEPA street sweeping to minimize tracking of contaminants throughout a community.
- Evaluate the feasibility of conducting the cleanup of residential areas in their entirety during the early removal phase if contamination is widespread. If this is not possible, limit the early removal actions to immediate risks (Tier 1 and Tier 2 residential properties, including residences with

elevated blood lead levels) in order to minimize the potential area where recontamination might occur.

- Provide informational fact sheets to homeowners on how to minimize recontamination on their property.
- Establish an ICP to manage cleaned areas through an agreement with local governments. This could involve a local government agency that is available to recommend best management practices for homeowner projects and provide education to the homeowner, as well as utility districts and companies likely to breach the barriers/markers put in place.
- Provide site plans or other documentation of areas that have been cleaned up, as well as information on areas that are still contaminated, to the local governmental entity responsible for the ICP and for tracking properties over time. The establishment of a geographic information system (GIS) to manage the ICP is suggested.

### **6.7.2 Long-term Remedial Action**

Some or all of the following measures may address the risk of recontamination during the long-term remedy implementation (Tiers 2 and 3) and post-decision document implementation phase:

- Evaluate the permanence of the various remedial activities under consideration for the long-term action. Consider the economic feasibility of complete contaminated soil removal to minimize reliance on an ICP.
- Conduct a cost analysis comparing long term ICP cost to those of complete removal (EPA, 2000e). For example, property depreciation, tax base impact, additional procedures/cost of utility work, flooding complications/costs, and long term ICP administration cost should be taken into account when comparing the cost of a partial removal of contaminants to a complete removal. Property depreciation, while possibly subtle for each property, may add up to substantial losses for the entire community in reference to a county tax base. Also, losses for an individual property over a lifetime of sales could add up to a significant cost. Following cleanup, increases in property valuation from source removal or drainage/infrastructure enhancements (and savings/in-kind services to municipalities) should be considered.
- Remedial action should strive to remediate the contamination in the community by segregable areas, such as a town, or a divisible segment of town. Each segregable area should be cleaned up as

quickly as possible (e.g., within one construction season) to minimize recontamination of cleaned properties and to compound the protection to human health (EPA, 2000d). Each community should be cleaned up block by block within these segregable areas, utilizing best management practices to mitigate tracking of contaminants. Site experience suggests that cleanup for up to 800 properties per site per year is possible.

- Fugitive dust that may be a source for recontamination, and access to such sources should be controlled. Air monitoring along with depositional modeling may be necessary to determine if windblown dust presents a significant threat of recontamination. Significant sources of windblown dust should be controlled prior to or simultaneously with cleanup of adjacent residential areas. Consider HEPA street sweeping during remediation and immediately following completion of cleanup to minimize tracking of contaminants throughout a community.
- Complete removal of contaminants should be considered in flood prone areas or areas with a high groundwater level due to the inherent difficulty in maintaining a soil cover remedy in a flood prone area. Drainageways containing contamination within their 100-year floodplain, which are not addressed in the remedy could also lead to remedy failure if the contaminants are eroded to other areas.
- Remediation of contaminated rights of way should occur within segregable areas simultaneously, if possible, or as close together in time as possible to minimize vehicle tracking and recontamination to driveways from the rights-of-ways.
- Control measures for all remaining sources, such as mining waste piles surrounding the community, should be developed to insure the remediated neighborhoods are kept clean. ICPs should be established to ensure the control, or proper use and disposal of any wastes remaining on site.
- If the residential remedy includes replacement of soils, removal of deteriorating exterior lead-based paint should be considered to minimize the soil recontamination potential.
- Other sources of residential property recontamination should also be considered. For example, homeowners may bring in contaminated soil for fill or other uses on their property.
- Establish permanent funding for an ICP. Unless all contaminants are removed, some level of institutional controls may be necessary. Early establishment of a program is the key to success of a remedy that consists of a partial removal of contaminants.

### 6.7.3 Institutional Control Programs (ICPs)

A key aspect of any remedy which leaves waste in place is the ICP (EPA, 2000e). Removal and placement of a soil barrier over contaminated soil requires a substantial effort on the part of local government to monitor the clean barriers/markers over time in order to ensure the effectiveness of the remedy. To establish an ICP, full support from local governments is necessary, e.g., the establishment of local ordinances to enforce maintenance of the barriers/markers is likely to be required. As long as contamination remains on-site above cleanup levels, ICs should be in-place.

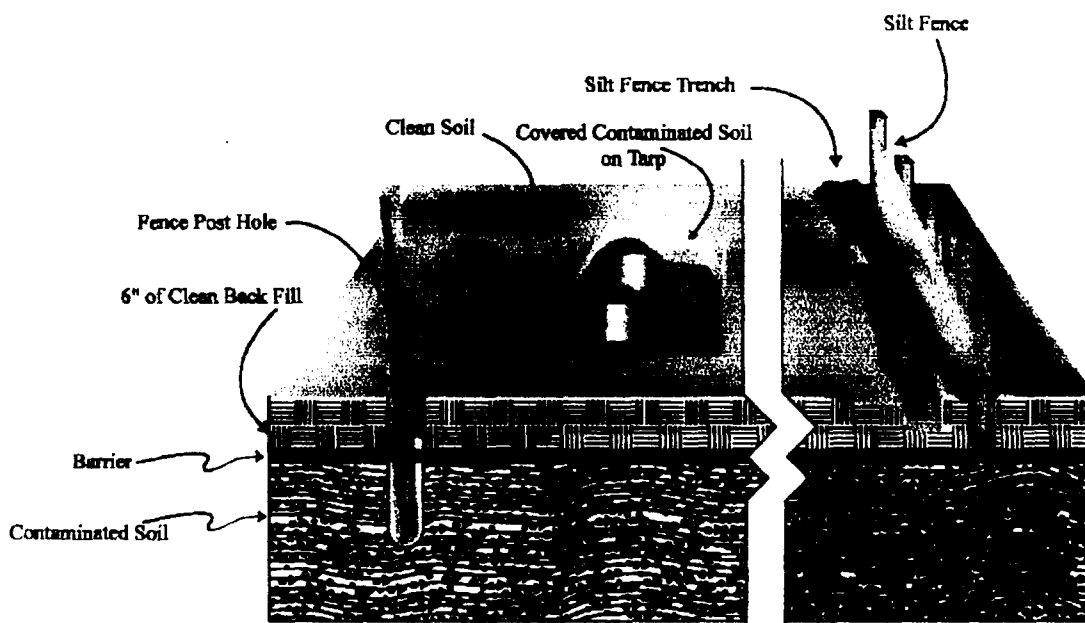
Education (see Section 3) is a key initial and ongoing component to support an ICP. Education and licensing of contractors who work on clean barriers/markers should generally be required (e.g., as part of a local ordinance) to ensure the longevity of the remedy. Also, at many sites (e.g., Bunker Hill) the ICP has been most effective when linked to the “call before you dig” program typically operated by many counties to avoid disruption of utility service.

The ICP should also create and maintain a database of properties that have been cleaned and those that have not, for the purposes of maintaining remedies. A record of remediated properties may also be useful for homeowners when they apply for loans, sell their homes, etc. A property database can also provide information on each property that is crucial for reducing the potential to impact site barriers/markers during the execution of typical property maintenance work (e.g., installing a garage, fence, etc.). Projects impacting barriers/markers should be permitted by the ICP, such that a prior- and post-inspection of the project is performed to ensure that BMPs have been followed. BMPs could be defined in a callout. BMPs include silt fences, hay bales, etc., to limit movement of contamination off a project site, and stockpiling of contaminated soil on a tarp to prevent contamination of underlying soil (Figure 6-3). These BMPs typically add about 5 percent to project cost (TerraGraphics, 2000). The local government implementing agency should have the means available to enforce compliance with the ICP to ensure protectiveness of the remedy. The ICP should also require periodic inspections of residential areas to see if there are disturbed areas that may not have gone through the approved ICP permitting process.

A disposal area may be needed to dispose of contaminated soil from the site to support typical homeowner projects, as some municipal landfills may not accept contaminated soil. In addition, a disposal area may be needed if certain materials at a site, such as carpets, fail TCLP and cannot be commingled with solid waste. It may even be appropriate for an ICP to provide free removal of contaminated soil and provision of clean soil to homeowners (but contractors may be required to pay for these services, or obtain material from approved sources) to encourage maximum compliance and further ensure the longevity of the remedy. “Clean” soil must be defined in the ICP; i.e., the maximum

concentration of lead (and perhaps other constituents) allowed in clean soil, and the required sampling frequency, should be specified in the ICP.

Over the long term, cleanups may not be possible at every property at the same time. A trust fund should be established for the site for the cleanup of properties that are deferred for various reasons, which should be implemented by a locally based ICP. In this manner, changes in property ownership over time may be more closely monitored to determine when cleanup at deferred properties might be appropriate (see Section 6.9). Local implementation of the trust fund will ensure that cleanup of these properties occurs as soon as possible, further ensuring the protectiveness of the remedy.



**Figure 6-3. Implementing Best Management Practices (BMPs) during construction work.** The barrier shown in the above figure represents one component of an Institutional Control Program (ICP). The purpose of an ICP is to minimize the potential for accidental exposure of humans during construction and maintenance activities on sites where wastes have been left in place. The staging of contaminated soil on tarps and/or in small buckets, and the installation of silt fences downgradient of the construction area are examples of BMPs intended to prevent the migration of contaminated material from the construction site. Please refer to Section 6.7.3 for further explanation.

## 6.8 CLEANUP DOCUMENTATION

Upon confirmation that initial yard sampling indicates a given residential yard does not exceed the lead cleanup level for the site, or upon the completion of the cleanup of a residential yard, a letter ("clean" letter) must be sent to the property owner documenting that EPA considers the lead level in the yard to be below the level of human health concern. Prior to issuing a "clean" letter, a property closeout form should be signed by the property owner, which documents the owner is satisfied with the restoration of the property. Examples of property closeout forms are provided in Appendix F. Any areas that are not cleaned up via the owner's request, such as gardens, should be noted in the "clean" letter. If contamination is not cleaned up to depth, this fact, along with protections (i.e., barriers/markers) that are put in place, should be stated in the "clean" letter. The "clean" letter provides official documentation to the property owner for use in future property sales or transactions. Sample "clean" letters are provided in Appendix G.

is to ensure that the buyer is made aware of the contamination, and not to rely on the seller to disclose that the property is contaminated; however, deed notices can have major drawbacks, which vary by the state and local governments. For example, sometimes the deed notices transfer with the property, and sometimes they don't. Understanding state and local ordinances, easements, etc., is essential to the decision of whether and how to pursue deed notices.

Rental properties are considered a business, where the owner of the property does not have the same rights of denying cleanup as private owner occupants, in that they are subjecting renter occupants to unacceptable risks from lead contamination. In the case of rental properties, EPA should order access for cleanup by UAO to all owners of contaminated rental property. To ensure the protection of occupants, enforcement of the UAO, through warrants if necessary, is required to clean up all rental properties with contamination greater than the cleanup level.

## 7.0 FIVE-YEAR REVIEW

Five-Year Review – Section 121 of CERCLA, as amended by SARA, requires that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a five-year review. The NCP further provides that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure be reviewed every five years to ensure protection of human health and the environment.

CERCLA §121(c) requires an assessment of certain remedial actions every five years on sites where contamination has been left on site (EPA, 2000a). Guidance for conducting five-year reviews has been issued (EPA, 2001h). The purpose of a five-year review is to evaluate the performance of a remedy to determine if the remedy continues to be protective of human health and the environment. Typically, at large lead sites, such as mining and smelting sites, the volume and areal extent of contamination is such that total removal of all

contamination above the health-based risk level is economically impractical. Contaminated wastes are generally left on site and covered with soil. The remedy for these types of sites typically includes some type of IC to address residual or encapsulated contamination. A five-year review can determine whether the remedy is stable (i.e., soil covers are undisturbed, and clean areas are not being recontaminated from sources remaining on the site). The review should also assess the ICP that was established for residual source control to determine its effectiveness in protecting human health. As described below, the five-year reviews at large lead sites may involve the collection and evaluation of substantial quantities of data and require significant up-front planning. Much of the following discussion may not apply to small sites.

At many sites, an exposure study was performed prior to any cleanup activities to determine blood-lead concentrations of children in the community. A follow-up exposure study of residents should be conducted during the five-year review to determine if the concentrations have decreased below levels of concern. If the blood-lead concentrations have not decreased to acceptable levels, additional environmental studies and individualized, follow-up exposure investigations should be conducted to determine the pathways of exposure that may need to be addressed. Long-term exposure studies can be very useful in understanding exposure trends at a site. They also can be useful to ensure that no pathways of exposure have been missed and to help identify areas of the site that have been recontaminated. In this manner, the project manager can use health data as a means to “double check” the effectiveness of the remedy and to corroborate environmental data. However, blood lead data from limited sampling should not be used as the only metric for gauging the success of a remedy, even if it can be used to identify specific problems. The project manager should coordinate with ATSDR and the local health district with respect to planning and funding such a program.

The five-year review should include resampling at a percentage of each type of property that was remediated during the cleanup actions. A baseline level of resampling should be designed to achieve a pre-specified level of statistical significance and power. If complete cleanup had not been selected, a higher resampling rate of each type of remediated property may be warranted. This sampling should assess the potential for recontamination that may be occurring, and may help identify any pathways that were missed during remediation. Any sampling that indicates widespread or clusters of soil levels above clean backfill concentrations should be monitored over time to determine if an upward trend exists that may jeopardize the remedy.

Additionally, some level of house dust sampling should occur to determine if levels are rising or falling. House dust, being a primary exposure pathway, should be used as one indicator of remedy effectiveness and also used to detect the presence of recontamination. Lead concentrations in house dust levels often correlate to interior lead-based paint, which is not usually addressed by Superfund (EPA, 1998b). Therefore, interior paint sampling should also be conducted as a component of the risk assessment to aid in determining the source of the lead loading to dust.

At large lead sites, remedy protectiveness issues will often relate to the implementation and management of ICs and recontamination of areas previously cleaned. The five-year review should evaluate the effectiveness of the site ICP and recommend corrections to address any deficiencies that are identified. In order for a five-year review to be effective at sites where ICs are the primary component in ensuring the effectiveness of the remedy, there needs to be: (1) clear documentation of the specific type of ICs that were required and implemented; and (2) accurate and complete tracking of subsequent activities and changes in property use following completion of the Superfund remedy.

The following are possible deficiencies for several types of commonly used institutional controls and other control measures taken to ensure the protectiveness of the remedy:

- HEPA vacuum loan program not being broadly used.
- Information on interior home cleaning not being widely distributed.
- Lack of access control along right of ways, and in unremediated areas.
- Inadequate decontamination of vehicles leaving areas of existing contamination.
- Erosion of unremediated areas onto remediated properties.

- Lack of or inadequate disposal area for snow (that contains contaminated soil).
- Lack of drainage infrastructure and maintenance by local entities
- Uncontrolled utility excavation in areas with contamination at depth.
- Inadequate road maintenance in areas where contamination exists at depth.
- Inadequate disposal capacity to handle ICP generated wastes.
- Discontinuation of, or diminishing, health education program.
- Decrease of blood-lead monitoring.
- Complicated/unfounded ICs and/or change in local government acceptance of ICs.

## 8.0 FEDERAL FACILITIES

The purpose of this section includes the following: (1) to provide direction to EPA Federal Facility RPMs that oversee response actions involving lead contamination of soils from lead-based paint in residential areas of federal facilities; (2) to build and elaborate on the joint March 1999 EPA and DOD Principles Memorandum (DOD/EPA, 1999a) and the December 1999 Lead-Based Paint Interim Field Guide (DOD/EPA, 1999b); (3) to address situations where the DOD service component will conduct the response actions and the regulatory agencies will be provide oversight; and (4) to address the unique considerations that arise when the federal government transfers contaminated property, using its CERCLA §120(h) authority, to non-federal private parties (e.g., states, local governments, and local reuse authorities [LRAs], etc.).

DOD facilities are required to conform to local building codes and standards and therefore must follow all federal and state ARARs. While existing policy, guidance, and directives on lead contamination are applicable at Federal Facilities, property transfer issues present unique requirements that necessitate this section. This section only applies to residential areas located on DOD properties that are contaminated with lead due to lead-based paint when [and where] the properties are being transferred to private entities. This section does not apply to non-residential areas of federal facilities nor does it apply to DOD facilities that are not being transferred.

Beginning in 1995, EPA and DOD began to address policy differences on the cleanup levels for lead in soils from lead-based paint. Under the Base Realignment and Closure (BRAC) program, EPA began to receive comments from states, developers, and local governments on the extent of cleanup of lead-based paint in soils required for property transfer. EPA maintained that contaminated federal property transfer falls under CERCLA jurisdiction and that lead from lead-based paint is a CERCLA hazardous waste. Therefore, CERCLA §120(h) requirements apply to the transfer of federal property contaminated with lead from releases of lead-based paint. DOD believed that because EPA does not use CERCLA authority to cleanup lead contamination from lead-based paint at all Superfund sites throughout the country, DOD was being unfairly treated and was cleaning up the BRAC sites at a higher cleanup level than private Superfund sites. DOD argued that lead contamination to soils from lead-based paint required more funding for cleanups and it was becoming a barrier for BRAC properties to be transferred.

In 1998, Sherri Goodman, Deputy Under Secretary of Defense (Environmental Security) and Tim Fields, Assistant Administrator for OSWER, met to discuss the management of lead-based paint at residential and non-residential areas at BRAC properties. In March 1999, this agreement was formalized as the 'Principles Memorandum' (DOD/EPA, 1999a). The Principles Memorandum stated that for

residential areas located on BRAC sites, Title X procedures provide an efficient, effective, and legally adequate framework for addressing lead-based paint in residential areas, and that as a matter of policy, CERCLA/RCRA would apply in limited circumstances. Therefore, EPA and DOD agreed that for residential areas that were being transferred, Title X regulations would apply and that CERCLA/RCRA would apply in limited circumstances. Residential real property is defined by Title X as real property on which there is situated one or more residential dwellings used or occupied, in whole or in part, as the home or residence of one or more persons. It is important to note that Title X defines residential property different than the Handbook.

Where EPA is involved in federal property transfers and there is a concern about lead contamination to soils from lead-based paint, EPA Regions will need to make a determination whether the property meets the requirements of CERCLA §120(h)(3). This section of CERCLA outlines deed requirements for transferring property and covenants indicating that all remedial actions have been taken at the site. As a matter of policy, EPA has determined that federal property contaminated with lead from lead-based paint must be evaluated based on its use, or its intended reuse, after the property has been sold or transferred to another private entity. EPA's determination should be based on an evaluation of lead contamination by either relying on existing and available information gathered through a combination of file searches and a review of existing data and/or a site risk assessment, which may require the collection and analysis of additional soil samples.

The soil sampling design should be specific to the site. The actual or suspected presence of lead does not necessarily require sampling. Factors to be considered before designing a sampling plan include, but are not limited to, the nature of the facility's operations, its operating records, the age of the buildings/structures under consideration, the maintenance schedule for the buildings/structure, visual inspection, and future use. Based on these factors, it may be reasonable to conclude that the potential risks proposed for lead may be acceptable and no further evaluation is needed. It may also be important to consider the ultimate disposition of the property once it leaves federal control. For example, the structures may be scheduled to be demolished, so that the abatement of the hazard may be addressed in the demolition process and may negate the need to conduct cleanup activities.

When EPA is involved, the RPM and, as appropriate, an EPA risk assessor should work with their counterparts from the lead Federal agency to develop a sampling design, where required, that would be scientifically appropriate, minimize the cost of sampling, and provide the information required for risk management decisions. This information could result in a "no further action decision", a conclusion that more extensive sampling is necessary, or, in some cases, a response action. All of these potential outcomes should be discussed with the lead Federal cleanup agency prior to the initiation of sampling.

If there is insufficient knowledge to make a conclusion about the risk at the site or if the initial sample results indicates an unacceptable risk from lead, data may be collected by a focused sampling of an environmental media to develop an improved understanding of the risk that may be posed by the lead exposure. It may be appropriate to determine that after visual inspection and/or focused sampling, and after consultation with an EPA lead expert, the lead from the area may not pose a significant risk that requires further evaluation. Risk evaluations should be based upon a number of factors including the reasonably anticipated future land use, exposure potential, ICs proposed or in place, and bioavailability. The Handbook user is encouraged to obtain detailed information on ICs and Federal Facilities in the document "Institutional Controls and Transfer of Real Property under CERCLA Section 120(h)3(A), (B), or (C)" (EPA, 2000f).

If the property has been used or will be reused as residential real property after transfer, the EPA RPM must verify that the lead Federal Agency has followed the Title X regulations and policies regarding sampling and risk assessment. As a guide to assist site managers in understanding Title X regulations and policies, EPA and DOD jointly issued a Field Guide (DOD/EPA, 1999b) that is used by EPA and DOD field personnel when assessing hazards due to lead-based paint. The field guide contains information on performing a Title X paint inspection and risk assessment and outlines the requirements for abating soil contaminated by lead-based paint

The Title X program, through the implementation of the new Title IV of TSCA, establishes certification programs and work practice standards to regulate lead-based paint hazard evaluation and abatement in target housing and child occupied facilities. There are two types of evaluations covered by Title X. The first evaluation is a paint inspection that includes a surface-by-surface inspection to determine the presence of lead-based paint. All painted surfaces with distinct painting histories are sampled. Usually the paint inspection is done by a combination of portable XRF devices and paint chip sampling.

The second evaluation is a risk assessment to determine if lead-based paint hazards exist. A risk assessment includes taking samples of all deteriorating paint, dust sampling and soil sampling. The final report recommends methods to deal with all lead-based paint hazards that were found, which could include interim controls or abatement. A comprehensive evaluation consists of a combination of a paint inspection and risk assessment. Paint inspections and risk assessment conducted in accordance with Title X must be performed by certified personnel. All results, whether positive or negative, must be disclosed at time of sale or rental.

The final TSCA 403 regulation (HUD, 2001), defines a soil-lead hazard as bare soil on residential real property, or on property of a child-occupied facility, that contains concentrations of lead equal to or

exceeding 400 ppm in the play area or an average of 1,200 ppm in the rest of the yard. EPA and DOD have agreed that as a matter of policy, for bare soil with lead concentration between 400 and 1,200 ppm, the lead federal agency in consultation with the regulators has the option of abatement or interim controls. Based on the final HUD 1012/1013 regulations (24 CFR Part 35) (HUD, 2001), federal agencies can transfer the control and abatement requirements to the purchaser, but by law the federal agency is responsible for performing the lead-based paint inspection and risk assessment and must assure that through contractual mechanisms, the purchaser has performed the abatement of the soil in accordance with Title X.

In cases where the EPA RPM makes a determination that actions taken to address lead-based paint

**Finding of Suitability to Lease (FOSL) – A process that has been established for leasing of property that cannot be transferred by deed because environmental restoration activities are still ongoing. The FOSL process also looks at the compatibility of a proposed reuse with ongoing restoration activities and identifies restrictions necessary to protect human health and the environment and prevent interference with the cleanup.**

hazards are sufficient (following the requirements outlined in the Field Guide), EPA will agree with the federal agency on the transfer documents and the covenant that all remedial action necessary to protect human health and the environment with respect to any such substances remaining on the property has been taken before the date of such transfer. In the case of BRAC sites, the EPA RPM can agree on the

Findings of Suitability to Transfer (FOST) or Findings of Suitability to Lease (FOSL) language, and/or the operating properly and successfully (OPS) determination as required by CERCLA. When an EPA RPM has unresolved questions as to whether actions at residential areas meet the requirements of CERCLA, she/he should raise these issues to the Federal agency and provide an opportunity for response. In the case of BRAC sites, it is proper to highlight these concerns in EPA's comments on the FOST/FOSL. Efforts should be made to determine that the purchaser is fully aware that EPA has questions about the condition of the property.

**Finding of Suitability to Transfer (FOST) – A process that has been established to identify and prepare property for transfer by deed. Such transfers are usually undertaken at a property where environmental response is not needed nor has been taken. However, under certain conditions, new authority now permits earlier transfer. The FOST process also looks at the compatibility of an anticipated reuse with completed restoration activities and identifies restrictions necessary to protect human health and the environment.**

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# **APPENDIX A**

## **Description of the Sections of Title X**

## Description of the Sections of Title X

### Title X Final Rules in Effect for ONLY Target Housing:

**Section 1012.** This rule establishes the requirements for those who get assistance or mortgage insurance from HUD. The requirements are HUD program specific, but only pertain to those who are involved with a particular HUD program.

**Section 1013.** This rule establishes the requirements for Federal Agencies that dispose of target housing that will be used for residential purposes.

**Section 1018.** Section 1018 requires that sellers and landlords disclose known lead-based paint and lead-based paint hazards and provide available reports to buyers and renters. Sellers and landlords must also provide a copy of *Protect Your Family from Lead in Your Home* (EPA, 1999a).

This is a joint rule between EPA and HUD. Section 1018 does not include "child occupied facilities"; EPA developed the concept of "child occupied facilities" under TSCA Title IV, the term is only in effect for TSCA four hundred (400) series rules.

### TSCA Final Rules in Effect for ONLY Target Housing and Child Occupied Facilities:

**Section 402/404 State Certification Programs** establishes a nationally consistent Federal Program for the certification of individuals and firms engaged in training, paint inspections, risk assessments, and certification of abatement workers, supervisors and training providers. There are two aspects of the program. States and tribes are encouraged to establish a program that as a whole, is at least as protective as EPA's Federal program. The State programs can be more protective. When a State program is approved, it becomes the Federal Program in that State.

If the State or tribe does not establish an acceptable certification program, EPA operates the national program in that State. Much of the work is done in the EPA Regional Office. As of December 2001, 39 States, the District of Columbia, and 2 tribes have EPA authorized programs. Two States with large populations, which do not have authorized programs, are New York and Florida.

**Section 403** establishes hazard standards for lead in paint, dust, and soil. Lead-based paint is a hazard if (1) it is deteriorated; (2) it is present on a friction surface that is subject to abrasion and the dust-lead levels on the nearest horizontal surface are equal to or greater than the applicable dust hazard standard; or (3) it is present on any chewable surface on which there is evidence of teeth marks. (Lead-based paint is statutorily defined as paint containing 1.0 milligram or more lead per square centimeter or 0.5% or more lead by weight.) Dust is a hazard if it contains 40 micrograms or more lead per square foot on floors or 250 micrograms or more lead per square foot on window sills. Soil is a hazard if it contains 400 parts per million or more in play areas or 1,200 parts per million or more in the rest of the yard.

This regulation also established the following clearance levels for interior dust: 40 micrograms lead per square foot for floors, 250 micrograms lead per square foot for window sills, and 400 micrograms lead per square foot for window troughs.

EPA's **Section 403** rule was intended to prioritize risks as opposed to being inclusive of situations in which risks of concern exist. Per the rule preamble, "*The hazard standard in this TSCA rule was intended as a "worst first" level that will aid in setting priorities to address the greatest lead risks promptly at residential and child-occupied facilities affected by lead-based paint*" (EPA, 2001a). While identification of lead hazards (as defined under TSCA) is a necessary part of the facility reuse process, a minimal approach that would insure only that the letter of the hazard standards are met may not protect against some important risks.

**Section 405** establishes standards of environmental sampling laboratories. The National Lead Laboratory Accreditation Program (NLLAP) is administered by the American Industrial Hygiene Association and the American Association for Laboratory Accreditation. All laboratory samples must be analyzed by an NLLAP accredited laboratory.

**Section 406b** requires that the pamphlet *Protect Your Family from Lead in Your Home* (EPA, 1999a) be distributed no more than 60 days before a renovation in the home.

### **TSCA Rules Being Developed**

**Section 402.** Renovation and remodeling requirements for target housing and child occupied facilities are being drafted as a proposed rule. Requirements for bridges and structures constructed prior to 1978 are being drafted for re-proposal. Both of these could include training, certification, and work practice standards.

**Lead-based Paint Debris.** This rule was not required by Title X, but the need was clearly there to treat portions of the debris from lead-based activities differently than the RCRA requirements. There are two categories of waste discussed. First is the paint chips and dust, sludges and filtercakes, wash water and contaminated and decontaminated protective clothing equipment that would continue to be subject to all the requirements of RCRA. Second is the "lead-based paint architectural component debris", which would be exempt from the Toxicity Characteristics rule including Toxicity Characteristic Leaching Procedure (TCLP) testing for lead only. This would allow disposal of these components at construction-demolition (CD) landfills.

Although the Pb Debris Rule is still being developed, in the interim, **EPA has issued a Memorandum that "Regulatory Status of Waste Generated by Contractors and Residents from Lead-Based Paint Activities Conducted in Households" - signed July 31, 2000.** This memo clarifies the regulatory status of waste generated as a result of lead-based paint (LBP) activities (including abatement, renovation activities, and remodeling) in homes and other residences. This memo explains why LBP generated by contractors in households is "household waste" and thus excluded from the RCRA Subtitle C hazardous waste regulations. The household exclusion applies only to waste generated by either residents or contractors conducting LBP activities in residences. As a result, LBP waste from residences can be discarded in a municipal solid waste landfill or a municipal solid waste combustor.

## **APPENDIX B**

### **Contacts and Software for Sampling Design**

Table B-1 Contacts and Software for Sample Planning Design		
Topic		Contact(s)
Sampling plan design/ Systematic Planning	General support	EPA HQ Quality Staff Phone: (202) 564-6830 FAX: (202) 565-2441 E-mail: <a href="mailto:quality@epa.gov">quality@epa.gov</a>
	Dynamic Field Activities	Internet: <a href="http://www.epa.gov/superfund/programs/dfa/index.htm">http://www.epa.gov/superfund/programs/dfa/index.htm</a>
Software	DEFT: Data Quality Objectives Decision Error Feasibility Trials	E-mail: <a href="mailto:quality@epa.gov">quality@epa.gov</a> Internet: <a href="http://www.ornl.gov/doe_oro/dqo/resdqo.htm">http://www.ornl.gov/doe_oro/dqo/resdqo.htm</a>
	FIELDS: Fully Integrated Environmental Decision Support	Internet: <a href="http://www.epa.gov/region5fields/static/pages/index.html">http://www.epa.gov/region5fields/static/pages/index.html</a>
	Geo-EAS: Geostatistical Environmental Assessment Software	E-mail: <a href="mailto:englund.evan@epa.gov">englund.evan@epa.gov</a> Internet: <a href="http://www.sph.umich.edu/~aelon/geoeas/">http://www.sph.umich.edu/~aelon/geoeas/</a>
	SADA: Spatial Analysis Decision Assistance	E-mail: <a href="mailto:sada@tiem.utk.edu">sada@tiem.utk.edu</a> Internet: <a href="http://tiem.utk.edu/~sada/">http://tiem.utk.edu/~sada/</a>
	VSP: Visual Sample Plan	E-mail: <a href="mailto:nell.cliff@pnl.gov">nell.cliff@pnl.gov</a> Internet: <a href="http://dgo.pnl.gov/vsp/">http://dgo.pnl.gov/vsp/</a>

## **APPENDIX C**

### **Example of Property Access Agreement Forms**

## CONSENT FOR ACCESS TO PROPERTY FOR SAMPLING

Name: \_\_\_\_\_ Daytime Phone Number: \_\_\_\_\_

Address(es) of Property(ies): \_\_\_\_\_  
\_\_\_\_\_

I consent to officers, employees, and authorized representatives of the United States Environmental Protection Agency (EPA) entering and having access to my property for the purpose of taking [DESCRIBE NUMBER OF SAMPLING LOCATIONS AND DEPTHS] which are necessary to implement the cleanup of lead contamination in the soil.

This written permission is given by me voluntarily with knowledge of my right to refuse and without threats or promises of any kind. I understand that EPA or authorized representatives of EPA will contact me at least one week in advance before the soil samples are collected. This agreement is only for the purpose of soil sampling and no other work.

\_\_\_\_\_  
Date

☐ I grant  
access to my property

☐ I do not grant  
access to my property

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

☐ I would also like EPA to have a lead expert contact me to schedule a free inspection to identify potential lead hazards in my home and provide safety tips.

**United States Environmental Protection Agency Region 6  
1445 Ross Avenue, Suite 1200  
Dallas, Texas 75202-2733**

**CONSENT FOR ENTRY AND ACCESS TO PROPERTY**

**Description of property (including address) for which consent to access is granted:**

**Example: XXXX Street, Texarkana, Arkansas, more particularly described as a lot measuring approximately 3,000 square feet, including a two-room wood structure of approximately 300 square feet**

**Name of Signatory:** \_\_\_\_\_

**Address:** \_\_\_\_\_

\_\_\_\_\_

**Phone:** (\_\_\_\_) \_\_\_\_\_

**Relationship to property (e.g., owner, lessee, agent or employee of owner, etc.):** \_\_\_\_\_

**I HEREBY CONSENT to officers, employees and parties authorized by the U.S. Environmental Protection Agency (EPA), entering and having continued access to the property described above at reasonable times for the following purposes (List the activities to be undertaken on the property):**

**Example:**

- **Sample collection including: (1) the gathering of soil from the outside area of the property; (2) drawing water from the tap; and (3) vacuuming the inside area of any inhabitable structure in order to collect dust.**
- **Taking photographs to record the sampling process.**

**I realize that these actions are undertaken pursuant to EPA's response and enforcement responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Sections 9601-9675. This written permission is given by me voluntarily with the knowledge of my right to refuse and without threats or promises of any kind.**

**This agreement expires on:** \_\_\_\_\_  
(Date)

**I HEREBY WARRANT that I have authority to make this access agreement.**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Signature**

\_\_\_\_\_  
**Print name**

## CONSENT FOR ACCESS TO PROPERTY TO TAKE RESPONSE ACTION

Name: \_\_\_\_\_ Daytime Phone Number: \_\_\_\_\_

Address(es) of Property(ies): \_\_\_\_\_  
\_\_\_\_\_

I consent to officers, employees, and authorized representatives of the United States Environmental Protection Agency (EPA) entering and having access to my property for the purpose of taking a response action including: 1) preparing for and excavation of soil from my property; 2) backfilling the excavated area(s) with clean soil and/or backfill; and 3) restoring any grass or other vegetation or structures to their pre-excavation state. These activities are necessary to implement the cleanup of lead contamination in the soil.

This written permission is given by me voluntarily with knowledge of my right to refuse and without threats or promises of any kind. I understand that EPA or authorized representatives of EPA will contact me approximately two weeks in advance before the removal of soil begins, to discuss the steps involved in the excavation and removal program and all measures EPA will take to restore my yard. I also understand that if there is any damage to structures such as sidewalks that is caused by the work conducted by EPA or authorized representatives of EPA, then EPA or authorized representatives of EPA shall repair such damage.

\_\_\_\_\_  
Date

☐ I grant  
access to my property

☐ I do not grant  
access to my property

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

## CONSENT FOR ACCESS TO PROPERTY FOR SAMPLING AND TO TAKE RESPONSE ACTION

Name: \_\_\_\_\_

Daytime Phone Number: \_\_\_\_\_

Address(es) of Property(ies): \_\_\_\_\_  
\_\_\_\_\_

I consent to officers, employees, and authorized representatives of the United States Environmental Protection Agency (EPA) entering and having access to my property for the purpose of sampling and taking a response action including: 1) preparing for and excavation of soil from my property; 2) backfilling the excavated area(s) with clean soil and/or backfill; and 3) restoring any grass or other vegetation or structures to their pre-excavation state. These activities are necessary to implement the cleanup of lead contamination in the soil.

This written permission is given by me voluntarily with knowledge of my right to refuse and without threats or promises of any kind. I understand that EPA or authorized representatives of EPA will contact me approximately two weeks in advance before the removal of soil begins, to discuss the steps involved in the excavation and removal program and all measures EPA will take to restore my yard. I also understand that if there is any damage to structures such as sidewalks that is caused by the work conducted by EPA or authorized representatives of EPA, then EPA or authorized representatives of EPA shall repair such damage.

\_\_\_\_\_  
Date☐ I grant  
access to my property☐ I do not grant  
access to my property\_\_\_\_\_  
Signature\_\_\_\_\_  
Signature

# QUAPAW TRIBE OF OKLAHOMA

## PROPERTY ACCESS CONSENT AGREEMENT FOR SAMPLING AND TO TAKE RESPONSE ACTION

The Property which is the subject of this agreement is described as follows:

NE 1/4 SE 1/4, Section 6, Township 28 North, Range 24 East, Ottawa County, Oklahoma otherwise described as Beaver Springs Park and Tribal Office which includes the Pow Wow grounds (hereinafter the Property).

THIS \_\_\_\_ DAY OF \_\_\_\_\_, 1999, by authority of the Quapaw Tribal Business Committee, permission is hereby granted to officers, employees and parties authorized by the United States Environmental Protection Agency (EPA) entering and having continued access to the Property until 4:30 pm (CST) on \_\_\_\_\_, to conduct the following work (hereinafter the work):

- 1) To perform necessary response actions (e.g., excavation of contaminated soil, backfilling with clean soil or gravel, and sodding or seeding) to address lead and other metals from mining waste contamination on the above-described lands in accordance with the EPA Record of Decision issued August 27, 1997;
- 2) To take necessary samples of environmental media to identify lead and other metals that may be a threat to public health or welfare or the environment.

Nothing contained in this permit shall operate to delay or prevent a termination of Federal trust responsibilities with respect to the Property by the issuance of a fee patent or otherwise during the term of the work; however, such termination shall not serve to terminate the work. The Quapaw Tribal Business Committee shall notify EPA of any change in status or ownership of the Property.

The Quapaw Tribal Business Committee realizes that the work will be undertaken pursuant to EPA's Superfund authority under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Sections 9601-9675.

This written permission is given by the Quapaw Tribal Business Committee voluntarily with the knowledge of its right to refuse and without threats or promises of any kind.

The Quapaw Tribal Business Committee is the property owner or a responsible representative of the property owner and I, Ed Rogers, as Chairman of that Committee, warrant that I have authority to make this access agreement.

\_\_\_\_\_  
Ed Rogers  
Quapaw Tribal Chairman  
Quapaw Tribe of Oklahoma

\_\_\_\_\_  
Date

\_\_\_\_\_  
U.S. Environmental Protection Agency

\_\_\_\_\_  
Date

## **APPENDIX D**

### **Example of Dust Abatement Access Form**

## CONSENT FOR ACCESS TO PROPERTY

Name: \_\_\_\_\_ Daytime Phone Number: \_\_\_\_\_

Address(es) of Property(ies): \_\_\_\_\_

I hereby consent to grant officers, employees, contractors, sub-contractors and authorized representatives of the United States Environmental Protection Agency (EPA) access to the interior of my home and/or property for the purpose of interior dust abatement. The home dust abatement program being offered at this time consists of vacuuming floors and walls with a special vacuuming system. This system is portable and compact and easy to use. A team of bonded representatives will be providing the service at no charge to the homeowner.

Videotaping of the interior of the residence will be necessary to provide backup documentation in the event of any claims. It will be necessary that someone remain at the residence for one or two days while it is being vacuumed. This lead abatement program is offered only to home owners who have or will grant access to their property for the remediation of in their yards. These activities are necessary to interrupt the movement of lead through soil dust, house dust, and paint dust.

If you want the process completed in your home and prefer to do it yourself, please note in the appropriate space and arrangements will be made to schedule the loan of a HEPA-VAC unit to you.

This written permission is given voluntarily with the knowledge of its right to refuse and without threats or promises of any kind. I understand that, if any damage to my property results from these activities or any work conducted by the USEPA or its authorized representatives, then the USEPA or its authorized representatives shall repair or replace such damage.

\_\_\_\_\_  
Date

- ☐ I grant access to my property for Representatives of the EPA to vacuum and video.
- ☐ I wish to make arrangements to vacuum myself.
- ☐ I do not grant access to my property.

\_\_\_\_\_  
Signature

Please return as soon as possible for scheduling of work. If you should have any questions please contact [LOCAL CONTACT NAME] at [PHONE NUMBER].

## **APPENDIX E**

### **Example of Property Inspection Checklist**

**TAR CREEK PROJECT  
PROPERTY HOME INSPECTION CHECKLIST**

\_\_\_\_\_  
**Address**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Property Group Number**

**Home Interior Access (check one, see comments):**

☐ **Approved by Property Owner**

☐ **Denied by Property Owner**

**Property (Yard) Access (check one, see comments):**

☐ **Approved by Property Owner**

☐ **Denied by Property Owner**

	OK	NA	PROBLEM/CONDITION
<b>YARD AREA</b>			
<b>1. Lawn Area</b>			
A. Location of Flower/Plant Boxes			
B. Soil (grade) next to house			
C. Shrubbery			
D. Trees			
E. Low areas near house (that could cause ponding of water)			
F. Other: _____			
<b>2. Utility</b>			
A. Water Meter			
B. Gas Meter			
C. Sewer Lines			
D. Other: _____			
<b>3. Driveway</b>			
A. Concrete cracked, damaged			
B. Blacktop cracked, damaged			
C. Uneven Settling			
D. Other: _____			
<b>YARD AREA (cont.)</b>			

	OK	NA	PROBLEM/CONDITION
<b>4. Streetwalk &amp; Walkways</b>			
A. Concrete cracked, eroded			
B. Tripping hazards			
C. Tree roots cracking, lifting slab			
D. Sections missing			
E. Other _____			
<b>5. Garage</b>			
A. Settlement cracks in walls			
B. Concrete floor slab cracked, damaged			
C. Door jambs damaged, rotted			
D. Door hard to open, close			
E. Other: _____			
<b>6. Swimming Pool (Above Ground)</b>			
A. Leakage			
B. Visible damage			
C. Other: _____			
<b>7. Swimming Pool (Below Ground)</b>			
A. Leakage			
B. Visible damage			
C. Other _____			
<b>8. Storm Cellar</b>			
A. Damaged			
B. Indication of Flooding			
C. Other: _____			

	OK	NA	PROBLEM/CONDITION
<b>YARD AREA (cont.)</b>			
<b>9. Electrical Service</b>			
A. Damaged circuit breaker panel box			
B. Wiring hanging outside			
C. Damaged electric meter			
D. Other: _____			
<b>EXTERIOR AREA</b>			
<b>10. <input type="checkbox"/> Brick <input type="checkbox"/> Siding</b>			
A. Brick bulging, spalling, cracking			
B. Mortar loose, needs repointing			
C. Lintel needs repair			
D. Stucco bulging, cracking			
E. Siding dented, damaged			
F. Finish wearing off siding			
G. Siding loose, not level, missing			
H. Siding rotted, termites			
I. Composite shingles worn, broken, missing			
J. Windows damaged			
K. Other: _____			
<b>11. Roofing</b>			
A. Age of covering			
B. Shingles worn, damaged, patched			
C. Brick chimney broken, leaning			
D. Joint open between chimney & exterior wall			
E. Need flashing at chimney, vents, walls			
<b>EXTERIOR AREA (cont.)</b>			

	OK	NA	PROBLEM/CONDITION
<b>F. Parapet wall leaning</b>			
<b>G. Roof sagging</b>			
<b>H. Metal flashing damaged, missing</b>			
<b>I. Other: _____</b>			
<b>12. Gutters &amp; Leaders</b> <input type="checkbox"/> Yes <input type="checkbox"/> No			
<b>A. Copper discolored, greenish, damaged</b>			
<b>B. Galvanized rusted, patched</b>			
<b>C. Fascia board rotted, damaged, patched</b>			
<b>D. Drain onto foundation wall</b>			
<b>E. Need to divert water from wall</b>			
<b>F. Soffit venting <input type="checkbox"/> Yes <input type="checkbox"/> No</b>			
<b>G. Concrete slab cracked, deteriorated</b>			
<b>H. Concrete slab/splash block need</b>			
<b>I. Other: _____</b>			
<b>13. Entrance Steps</b>			
<b>A. Concrete cracked</b>			
<b>B. Brick cracked, mortar loose</b>			
<b>C. Structurally sound</b>			
<b>D. Handrail</b>			
<b>E. Other: _____</b>			
<b>14. Exterior Doors</b>			
<b>A. Damaged</b>			
<b>B. Opens/closes freely</b>			
<b>C. Weatherstripping</b>			
<b>D. Trim rotted, missing</b>			
<b>EXTERIOR AREA (cont.)</b>			

	OK	NA	PROBLEM/CONDITION
E. Jambs rotted, damaged			
F. Frame separation from walls			
G. Other: _____			
<b>INTERIOR AREA</b>			
<b>15. Windows</b>			
A. Trim/sills rotted			
B. Broken glass			
C. Open freely			
E. Frame separation from walls			
F. Other: _____			
<b>16. Kitchen</b>			
A. Cracked walls, ceiling			
B. Loose nails, tape on drywall			
C. Soft, springy floors			
D. Wood, tiles on floor damaged			
E. Faucet leaks			
F. Doors don't close			
G. Cabinets don't close			
H. Moisture in cabinets			
I. Walls have moisture damage			
J. Other: _____			
<b>17. Interior Rooms</b>			
A. Cracked walls, ceiling			
B. Loose nails, tape on drywall			
C. Soft, springy floor			
D. Carpeting water damaged			
E. Water stains near windows			
<b>INTERIOR AREA (cont.)</b>			
F. Mold/mildew on walls			

	OK	NA	PROBLEM/CONDITION
G. Other: _____			
<b>18. Toilet Facility</b>			
A. Cracked tile, plaster on walls			
B. Cracked plaster on ceilings			
C. Loose tiles on walls, floors			
D. Loose nails, tape on drywall			
E. Toilet cracked			
F. Water leaks at closet flange			
G. Grout missing around tub			
H. Shower pan damaged, missing			
I. Shower door damaged, missing			
J. Need new shower door			
K. Water stains on ceiling below bathroom			
L. Hot water heater tank corroded			
M. Water stains on floor around hot water heater			
N. Moisture present around hot water heater			
O. Other: _____			
<b>19. Interior Doors</b>			
A. Open freely			
B. Frame separation from walls			
C. Other: _____			
<b>20. Attic</b>			
A. Only if visual indicator			
B. Other: _____			

	OK	NA	PROBLEM/CONDITION
<b>INTERIOR AREA (cont.)</b>			
<b>21. Foundation</b>			
A. Minor cracks			
B. Settlement cracks at corners, walls			
C. Wall bulging inward			
D. Seepage into basement/cellar			
E. Mortar deteriorating			
F. Other: _____			
<b>22. Basement or Cellar</b>			
A. Seepage, water stains on floor/wall			
B. Sump pump installed			
C. Water pipe leaks			
D. Sewer pipe leaks			
E. Other: _____			
<b>FOUNDATION AREA</b>			
<b>23. Foundation (Slab on Grade)</b>			
A. Settlement cracks			
B. Joint separation			
C. Spalding			
D. Other: _____			
<b>24. Foundation (Elevated Slab w/Crawl Space)</b>			
A. Concrete support integrity			
B. Evidence of moisture or visible moisture in crawl space			
C. Evidence of water accumulation (e.g., water stains)			
<b>FOUNDATION AREA (cont.)</b>			

	OK	NA	PROBLEM/CONDITION
D. Sagging joist/support girders			
E. Fungus growth evident			
F. Sump pump evident			
G. Vents present			
H. Vapor barriers			
I. Pier settlement			
J. Uneven subgrade			
K. Insect damage			
L. Sill plate damaged			
M. Subfloor damaged, loose			
N. Need subfloor			
O. Other: _____			
<b>25. Plumbing (Raised Floors Only)</b>			
A. Pipe insulation crumbling, missing			
B. Need to insulate pipes			
C. Water pipes leaking			
D. Sewer pipes leaking			
E. Water pipe condition			
F. Other: _____			
<b>26. Plumbing</b>			
A. Water pipe conditions			
B. Sewage pipe conditions			
C. Pipes leaking			
D. Pipe insulation			
E. Corrosion on drain lines			
F. Other: _____			
<b>27. Other Area</b>			
A. _____			

	OK	NA	PROBLEM/CONDITION
B. _____			
C. _____			
D. _____			

COMMENTS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Topo Survey Requested ☐ Yes ☐ No

\_\_\_\_\_  
Inspector Signature

\_\_\_\_\_  
Date

## **APPENDIX F**

### **Example of Property Closeout Forms**

# USEPA REMEDIATION AGREEMENT FORM

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_  
MADISON, IL 60600

This form documents the completion of remedial activity performed on my property. I  
signature will designate that I am satisfied with the restoration of my property, and that no items  
in question, now, or at any time in the future, except those items listed below, if any.

Comments: 100% of area completed

Restoration items in question:  
None

1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_  
4. \_\_\_\_\_  
5. \_\_\_\_\_  
6. \_\_\_\_\_  
7. \_\_\_\_\_

Responsible Signature: \_\_\_\_\_  
Printed Name: \_\_\_\_\_  
Date: 11/29/98

USEPA Representative Signature: \_\_\_\_\_  
Printed Name: Brad Bradley  
Date: 11/13/98

# RESIDENTIAL REMEDIATION INSPECTION/AGREEMENT FORM

Name

Address

Phone

This form documents the completion of remedial activities performed on my property. My signature will designate that I am satisfied with the restoration of my property, and that no items are in question, now, or at any time in the future, except those items listed below, if any.

Comments:

## Restoration Items in Question:

1. Roll netting on soil to be trimmed off
2. Along left side, more stone to be added - top of building
3. At double doors back left corner add rock up to lip to
4. allow vehicle to open. Also add rock at back of building
5. in middle in front of concrete ledge. Also add rock
6. in open parking area & grade the tops of the high spots.
7. On outside of fence on 7<sup>th</sup> street clean up dirt clods rolling under safety fence

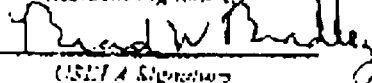
Property Inspection Date

12-4-98

Lawrence Instructions Reviewed/Delivered

12-4-98

Resident Signature



USIA Signature

Printed Name

Brad Bradley

Printed Name

Date

12/9/98

Date

## **APPENDIX G**

### **Examples of Clean Letters**

**EPA LOGO AND ADDRESS**

**Date**

**Name**

**Address**

**City, State Zip**

**Dear :**

**The U.S. Environmental Protection Agency (EPA) has completed the cleanup of the lead contamination in your yard located at [ADDRESS, CITY, STATE], in connection with the [SITE NAME] site in [CITY, STATE] (the Site). By way of this letter, U.S. EPA is certifying that your yard has been cleaned up to less than [CLEANUP LEVEL] parts per million lead, the level which U.S. EPA considers protective of children's health at the Site.**

**Thank you for your cooperation in this cleanup effort. It has been our pleasure to work with you. If you have any questions concerning this letter or need further information, please contact me at [PROJECT MANAGER'S PHONE NUMBER].**

**Sincerely,**

**[PROJECT MANAGER NAME]  
Remedial Project Manager**

## EPA LOGO AND ADDRESS

Date

Name

Address

City, State Zip

Dear :

The United States Environmental Protection Agency (U.S. EPA) has sampled your yard located at [ADDRESS, CITY, STATE] for lead. The results of this sampling, which are enclosed with this letter, indicate that your yard contains less than [CLEANUP LEVEL] per million lead, the level which U.S. EPA considers protective of children's health at the [SITE NAME, CITY, STATE]. Thus, U.S. EPA will not need to perform soil cleanup activities in your yard.

If you have any questions concerning this letter or the enclosure, please contact me at [PROJECT MANAGER'S PHONE NUMBER].

Sincerely,

PROJECT MANAGER NAME  
Remedial Project Manager

Enclosure

ENCLOSURE

Analytical results for [ADDRESS] in parts per million (ppm) of lead:

<u>Depth Zone</u>	<u>Front Yard</u>	<u>Back Yard</u>	<u>OR</u>	<u>Quadrant 1</u>	<u>2</u>	<u>3</u>	<u>4</u>
0 to 1 inches	___ ppm	___ ppm		ppm	ppm	ppm	ppm
1 to 6 inches	___ ppm	___ ppm		ppm	ppm	ppm	ppm
6 to 12 inches	___ ppm	___ ppm		ppm	ppm	ppm	ppm
18 to 24 inches	___ ppm	___ ppm		ppm	ppm	ppm	ppm
deeper zones (if applicable)							

Drip Zone Composite    \_\_\_ ppm